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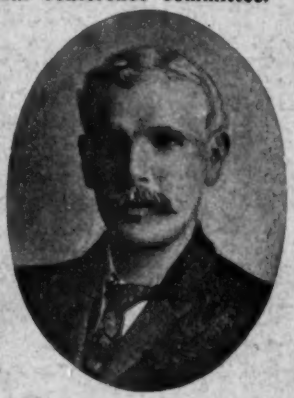

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SCARBOROUGH.

THE QUEEN OF WATERING-PLACES.

ENDOWED with a unique position and rare natural beauty, Scarborough has been further adorned by a lavish expenditure on public gardens, marine drives, promenades, and the like; so that she still stands, as she always stood, without a rival in Britain.

The rise of Scarborough as a watering-place dates from the discovery in 1620 of the mineral springs that led to the establishment, some seventy years later, of the old "Spaw." The fame of the waters soon spread. The opening of the eighteenth century saw the town rapidly becoming one of the most fashionable watering-places; and it remained till some twenty-five years ago a somewhat exclusive and "select" summer resort.

Nowadays it is many-sided, and appeals to all classes.

The most striking feature of Scarborough is its grand coast-line, which takes the form of two magnificent bays, separated by the Castle Hill, and stretching altogether a distance of four and a half miles. Each of the bays has an individuality of its own, and each claims its special patrons.

The South Bay forms a splendid curve from the Castle Hill to the White Nab. The old town and the harbour lie under the Castle Hill, the Grand Hotel and St. Nicholas' Gardens adorn the centre of the bay, and the Spa Grounds and Holbeck Gardens set off the cliffs to the south. A fine level stretch of smooth sand occupies the whole length of the bay, except where, south of the Spa, it gives place to "the Rocks." Though the South Bay ends strictly at the White Nab (otherwise called "the First Point"), the view from the Grand Hotel suggests one continuous sweep from the Castle Hill to the distant Filey Point, where the white waves are seen breaking perpetually on the Brig.

In this fine vista the Spa claims first place. To hundreds of visitors Scarborough and the Spa are interchangeable terms. Originally a small retreat for "taking the waters," it is now the gayest and the most select, as it is indeed the most beautiful resort in the town. It combines a fine promenade on the sea-front, a Grand Hall, where high-class concerts are periodically given (and where Conference will meet in Easter 1906), a theatre seating 800, a superior café, and numerous minor accessories. The whole cliff up to the very summit is laid out in terraced walks, with seats and arbours in plenty at points of vantage commanding fine views of the bay.

If the Spa were not such a delightful rendezvous for the young and robust, we should hear a good deal more about the medicinal value of its mineral waters, so famous in the past. The wells are under the kiosk at the north end of the Promenade. There are two springs, the North and the South. Both are rich in iron and in sulphate of magnesia, and both are therefore tonic and aperient. The South excels as a tonic, and the North as an aperient.

Close to the Spa at its south end is a little bay, rightly called "the Children's Corner," given up by universal consent to youthful engineers and architects in sand. Then come "the Rocks"—cliffs with miniature caves, and a long, low reef, whose pools are the delight of young and old. Here crabs and shrimps and fishes abound, and seaweeds, red and brown and green; and at low water sea urchins, spider crabs, and a host of other treasures are met with. The walk along the rocks round the White Nab (at the south end of the bay) into Carnelian Bay is perfectly safe when the tide is ebbing or low, and the return may be made by way of the cliff and Holbeck.

The two groins that run out on to the Rocks mark the position of Holbeck—a splendid example of the enterprise of the people of Scarborough. Twenty years ago this was a wild and neglected ravine. In 1887 it was drained and laid out as a public pleasure-ground. Its natural advantage of form, and the artistic way in which this advantage has been seized, make Holbeck exceedingly popular with both visitors and townsmen.

The esplanade runs along the whole length of the sea-front of the South Cliff, from the Spa Bridge to Holbeck Gardens. Like Holbeck, it is public property, and like Holbeck and all the walks, drives, and pleasure-grounds in and around Scarborough (with the single exception of the Castle Foot Drive), it is *free*.

SCARBOROUGH FROM OLIVER'S MOUNT.

The miserable British habit of enclosing every pretty corner of the land and putting a toll on it has not reached these shores.

A peculiar custom in connection with the Esplanade is the "Church Parade." After the Sunday morning service, numbers of visitors and residents betake themselves thither. In the season, in particular, the Promenade is crowded from end to end. The illustration will sufficiently indicate that the main object is "to see and to *be seen*."

From the Church Parade to the fish market is not by any means a descent from the sublime to the ridiculous. A morning visit to the West Pier when the boats are running in and landing their catch is very refreshing.

The litter from the trawlers is even more interesting than the fish. Squids and cuttlefish (cut up for bait), marvellous crabs, sea urchins, queen oysters (*Pecten*), sea anemones, including the lovely white compound anemone *Alcyonium*, and a host of other treasures of the deep, lie scattered about on the pier, and zoophytes (the so-called white seaweeds) hang in festoons from the nets. Most of these creatures are alive, and will, if placed in a jar of sea-water, display such beauty as will be a surprise to most "nature students" who see little of the shore.

The sea near the shore swarms with fish; and on a warm, still summer evening all things are possible to the amateur. A little fleet of twenty or thirty cobbles anchors in the bay, the boatman supplies line and bait, the fish hook themselves on, and the tyro is kept busy for an hour or two. He is a proud man as he toils home to his lodgings with his catch strung on a string. A score or two of fine haddock (whiting when they are skinned), billet, gurnard, and dabs rejoice his heart, and *to a much less extent* that of his landlady! More "scientific" is the sport of the Rock Anglers' Club, the members of which fish, for cod chiefly, with rod and line, in fine weather and foul, from the Far Pier, the Marine Drive, and the Rocks.

On the Foreshore Road, close to the harbour, is the Lifeboat House. The splendid services of the boat and its predecessors are recorded on the walls, and the boat may be examined at any time. Only those who have seen the North Sea in a real storm can appreciate the noble services of the fishermen who man her.

The old town is invariably spoken of as "down t' street," the street referred to being Newborough and Eastborough, which lead to it. The quaint old alleys, "steps," and "yards" should on no account be missed by delegates with antiquarian tastes, or by the amateur photographer in search of picturesque bits. In spite of evidences of poverty—for fishing is "not what it was" before the days of the steam trawler, when the men owned their own boats—there is much to interest. A walk, or rather a climb, through such streets as Quay Street, Whitehead Hill, Castle Gate, and Church Stairs Street, brings vividly before the imagination the simple prosperity of the sailors and fisher-folk in the days when

> "Years rolled on, and found old Scarbro' still
> A little village nestling 'neath a hill."

In those days Scarborough built her own ships, which traded far and wide, and Princes Street was the residence of well-to-do merchants.

The foundation stone of the Marine Drive was laid in the year of the Diamond Jubilee, 1897. It has thus taken nine years to complete, and the total cost of it, including the cost of the approach road in front of the harbour, will amount, according to official estimates, to over £126,000. The engineering difficulties that had to be faced in its construction were tremendous. Nine years ago the

BRITISH MUSEUM

foot of the Castle Hill was a wild and picturesque waste of massive blocks, fallen in the course of ages from the cliff above. All this material had to be broken up by blasting. In the next place, the greater part of the sea wall had to be built *in* the sea, and much of it could only be done when calm weather and exceptionally low tides gave a few brief opportunities for a few successive days together. Thirdly, the hard brown sandstone which forms the foundation of the first few yards at the south end of the wall, rapidly gives place to a foundation of soft shale (the Oxford clay of the geologist), and the difficulty of securing for practically the whole length of the wall a firm foothold in this material has been well-nigh insurmountable. Lastly, the engineers have had to encounter the gales of successive winters; on two occasions these gales tore to pieces the gantry—a vast structure which ran round the whole Castle Foot carrying cranes, trucks, and materials—and strewed the huge balks of timber on the south shore.

The wall itself is built of concrete blocks weighing from one and a half tons at the top of the wall to nine tons in the toe. It is backed by concrete in the mass. Over 71,000 cubic yards of concrete were used; and the scarping down of the face of the Castle Hill supplied hundreds of thousands of cubic yards of material for filling in. The top of the wall is 19 feet above high-water mark, the Drive is 60 feet in width—20 feet being footpath and 40 feet carriage road—and an inner wall runs round to intercept any material that may crumble from the cliff.

SCARBOROUGH. SOUTH BAY FROM SPA GROUNDS. *Photo by A. E. Cuttle.*

This great undertaking becomes this year an accomplished fact—a gigantic monument to the sacrifices which the inhabitants of Scarborough are prepared to make in order to keep the town in the foremost rank of European watering-places. The Drive now forms, with the Foreshore Road in the South Bay and the Royal Albert Drive in the north, a *continuous drive of two and a half miles*—the finest Marine Drive in Britain. It only remains to complete the scheme by carrying round the Castle Foot the electric tramway, which will in a short time run the whole length of this unrivalled sea-front.

A brief survey of the Castle Hill will make more real the stirring scenes that are connected with it. The Castle, which was built in Stephen's time, conforms in all essentials to the typical plan of a Norman castle, modified, however, by a master hand which made the most of every natural advantage, and completed a stronghold which has never once been taken by storm.

Before entering the outer gate we notice the deep fosse or dyke running the whole length of the hill on the west side. This hill is now known as "the Castle Dykes." Along its summit runs the long rampart, with bastions here and there, battlemented above, and pierced with eyelets for marksmen. Where the dyke meets the wall it passes under an arch that marks the exact spot where the drawbridge stood till some time in the nineteenth century. There is here a natural gap—due to a "fault"—in the long, narrow tongue of rock that forms the natural approach to the Castle.

Before passing through the outer gate (formerly protected by a portcullis) we notice the arms of England and France quartered on one of the towers that guard it. Turning sharply to the left within the gate, we clamber up into the ruins of an outwork which flanks the approach road. This is the formidable Bushell's Battery, which proved such an obstacle to the besiegers in 1644. Splendid views of both bays, the town, and the distant hills may be had from this battery.

We cross the drawbridge—or what was once the drawbridge—and ascend the steep, narrow path. Very little remains of the works that once rendered this approach impregnable. There was an inner gate,

with portcullis and flanking towers; there was also a second drawbridge; and a third gate and two strong towers kept the steep ascent to the Ballium or inner court, in which stands the Keep itself. All these defences have been swept away by war and time. Arrived in the Castle Yard, we see on the right the high mound and wall enclosing the Ballium, the last resort of the beleaguered garrison. Ancient drawings prove the square, massive Keep to have been not less than 120 feet high, with an embattled parapet. Its ruins stand 97 feet, and its walls are 12 feet thick There is little to see now in the Keep itself.

The Castle Yard, or Castle Garth, as the old people still call it, covers seventeen acres. It was once much larger; frequent falls of cliff, even in recent times, have cut off slice after slice. It is to be hoped that the sea wall will preserve what is left. In the yard there formerly stood a "praty chappyll of our Ladye, and besyde y^{e} same chappyll is a fayre well." The chapel has disappeared, but the "Lady's Well," the mainstay of many a hard-pressed garrison, flows on. A few relics of the ancient chapel have been unearthed from time to time.

At the south-east corner of the yard is a flight of steps, the romantic descent to what was the South Steel Battery, half-way down the cliff. Like Bushell's Battery, it was built in the days of the Civil War. It has been destroyed during the building of the Marine Drive.

This south-east corner of the Castle Yard recalls the honoured name of George Fox, "the first of the people called Quakers." There formerly stood in this corner the formidable Charles's Tower, round which during the siege some of the fiercest fighting took place. In the shattered remnants of this tower, Fox was imprisoned for conscience' sake in the days of Charles the Second, of unhallowed memory. "The wind drove in the rain forcibly . . . the water came over my bed . . . I was forced to skim it up with a platter. A threepenny loaf lasted me three weeks, and most of my drink was water with an infusion of wormwood." So much for the promises of a king.

As we leave the Castle Yard, we pass the drinking fountain erected to the memory of Thomas Hinderwell, the historian of Scarborough. He lies buried in the neighbouring churchyard. There also is the grave of Anne Brontë, sister of Charlotte Brontë. The family often visited Scarborough, and Anne died here in 1849. Her grave lies near to, and half-way along, the brick wall that faces the fountain. An urn in relief on the gravestone will serve to point out this hallowed spot to the many visitors who revere the memory of the gifted three.

THE CHURCH PARADE. *Photo by A. E. Cuttle.*

Many visitors prefer the North Bay to the South. It is always fresh and bright and breezy, quieter in the height of the season, and farther from the bustle of the town. Its attractions include a fine promenade on the cliff (Queen's Parade), with a splendid sea view; the Royal Albert Drive at the foot of the cliff, now connected up with the new Marine Drive; the Clarence Gardens, with spacious walks, and seats and "shelters" in plenty; and a kiosk, where a band plays daily in summer—all *free;* and last, and perhaps best, the yellow sands, where there is plenty of space for the children. The Clarence Gardens were laid out at the public expense in 1890, and opened by the late Duke of Clarence. Their great popularity is the best proof of the wisdom of the undertaking.

The fine Town Hall stands on the cliff in St. Nicholas' Street. A statue of Queen Victoria stands on the lawn, placed there by public subscription. The Gardens below form a charming retreat, well-treed and shady, in the very centre of the town. The rockeries are specially interesting. The Gardens were opened to the public in 1890. They are, of course, *free;* and they can be entered either from the cliff or from the Foreshore Road.

The Valley separates "the town" from the South Cliff. Formerly a beck, now covered in, ran through it to the sea. The fish pond was a mill dam, and one of the old millstones may be seen in the garden close by. The Valley is now a public park, a pleasant resort for those who love quiet. From the Valley Bridge the visitor gets a good view of the new Municipal School; and from the bridge he may look *down* into the rooks' nests in the tops of the tall elm trees!

Last and greatest of the "sights" is Oliver's Mount, reached by way of the South Cliff. The South Cliff is the more aristocratic part of Scarborough, and some of its newest streets are well worth a visit. From Oliver's Mount, Cromwell blew down the Castle—so says tradition, false of course. From the top of the mount there is a grand view of the town, the sea, and the moors, which amply repays the climb of five hundred feet above sea-level. The mount is public property. The sides are wooded and laid out with paths, and the descent on the west side leads down to the *Mere*, our only sheet of fresh water of any size.

It is only necessary to add that most parts of the town are now easily reached by the tram cars. The tramway, only opened in 1904, has already proved a great boon to visitors, who can now find accommodation farther from the sea without inconvenience. The cars run to the North Sands, the Harbour, the South Foreshore Road, and the Spa.

OBITER DICTA.[1]

WHEN a man attains an eminent public position it is the usual and natural thing to refer to his earlier work, whether literary or otherwise, for material by which to judge the man. The issue of a collection of essays by the President of the Board of Education will be welcomed by all who are interested in educational policy and in the man to whom is committed the direction of that policy. But some may ask, "What are *obiter dicta?*" and after hearing *strata* and *curricula* used at a recent Conference in the singular, we should not even be surprised if the question took the form, "What is an *obiter dicta?*" In order to remove all doubt on this point the title-page of the book in question contains a quotation from an "Old Judge," to the effect that "an *obiter dictum*, in the language of the law, is a gratuitous opinion, an individual impertinence, which, whether it be wise or foolish, right or wrong, bindeth none—not even the lips that utter it." The title, therefore, is in itself an answer to any one who might seek to bind the writer by any expressions of opinion found in the book. Opinions are expressed freely and copiously, and many of them bear on the work over which Mr. Birrell is now called upon to preside, and although these expressions cannot be taken as pledges of any future line of action in educational administration, yet the whole of this little book is a pledge that the President of the Board of Education is a deep thinker, that he is liberal minded, is a thorough student of our best literature, and also—and probably as a result—can set out his thoughts in fascinating language.

Of the seven essays in the present collection the first two are fine pieces of literary criticism, or at least the first may be regarded as a splendid example of analytical criticism. Here we have a search into the merits of Carlyle—an investigation of his characteristics, or "the invariable indications of Mr. Carlyle's literary handiwork—the tokens of his presence." In a summary the writer thus sets them out:—

"These, then, I take to be Carlyle's three principal marks or notes: mysticism in thought, realism in description, and humour in both."

The second essay deals with the "Alleged Obscurity of Mr. Browning's Poetry," and is rather of the nature of a defence than a criticism. Admirers of Browning will feel thankful to Mr. Birrell for his vindication of their favourite, and those who have been deterred from taking up Browning will find many of the supposed obscurities disappear on reading these pages. He does not claim that Browning's chief merit is simplicity, but that he is lucid to all who try to understand him. "Lucidity is not simplicity. A lucid poem is not necessarily an easy one. A great poet may tax our brains, but he ought not to puzzle our wits. We may often have to ask in humility, What *does* he mean? but not in despair, What *can* he mean?"

In the third essay, entitled "Truth-hunting," the writer reveals to us his intense admiration for Charles Lamb, and in the fourth his small appreciation of the actor's profession.

In the "Rogue's Memoirs," which deals with Cellini, we find some deep thoughts as to why some biographies prove so much more absorbing than others.

The "Via Media" will supply food for thought to those who are wrangling over "Religious Difficulties," and the essay on Falstaff will delight every one, especially those who are familiar with those historical plays of Shakespeare in which the bulky knight appears.

We might quote these delightful pages to any extent were it not for a conscientious respect towards the rights of publishers. We cannot refrain from a few samples of Mr. Birrell's peculiar blend of wit and humour, which often contains a large amount of deep truth. Thus:—

"We shall do well to remember, with Carlyle, that the best of all Reform Bills is that which each citizen passes in his own breast, where it is pretty sure to meet with strenuous opposition."

Again, in pleading for poetry which has not the merit of antiquity to ensure its continuance, he says:—

"In these bad days, when it is thought more educationally useful to know the principle of the common pump than Keats' 'Ode on a Grecian Urn,' one cannot afford to let any good poetry die."

What can be finer than the three following specimens:—

"No record of his art (the actor's) survives to tell his tale or account for his fame. When old gentlemen wax garrulous over actors dead and gone, young gentlemen grow somnolent. Chippendale the cabinetmaker is more potent than Garrick the actor. The vivacity of the latter no longer charms (save in Boswell); the chairs of the former still render rest impossible in a hundred homes."

"Falstaff was *not* habitually truthful. Indeed, that Western American who wrote affectionately of a comrade, 'As a truth-crusher he was unrivalled,' had probably not given sufficient attention to Falstaff's claims in this matter."

And, "Falstaff, like so many boys since his time, left his home in the country and came to London.

[1] *Obiter Dicta*, by the Right Hon. Augustine Birrell, M.P., President of the Board of Education. Hodder and Stoughton.

His brothers and sisters he left behind him, and we hear no more of them. Probably none of them ever attained eminence, as there is no evidence of Falstaff's having attempted to borrow money of them."

There is a charming irony in the passage:—

"To attempt to tell the story in better words than Shakespeare would occur to no one but Miss Braddon, who has epitomised Sir Walter, or to Canon Farrar, who has elongated the Gospels."

But with all his powers of irony and satire Mr. Birrell never relapses into "sarcasm" in its original sense of "tearing the flesh." There is a gentleness about it all and a fine consideration for the feelings of others, even political opponents. In this matter his precepts and practice agree. Thus we find him obliged to condemn Carlyle for his vituperations, although he endeavours to excuse him, and he writes in terms that recent political disputes may even leave open to question:—

"Still, all allowances made, it is a thousand pities; and one's thoughts turn away from this stormy old man and take refuge in the quiet haven of the Oratory at Birmingham, with his great Protagonist, who, throughout an equally long life spent in painful controversy, and wielding weapons as terrible as Carlyle's own, has rarely forgotten to be urbane, and whose every sentence is a 'thing of beauty.'"

But, as we have said, one great feature of these essays is the breadth of mind and the tolerance shown, both in literary matters and in matters of religion. As an example of this in matters literary we may refer to the end of the essay on Browning, in which, after pleading the claims of the poet to immortality, he says, "But love of Mr. Browning's poetry is no exclusive cult," and speaks in high praise of the works of other modern writers, finishing with this advice:—

"Let us be Catholics in this great matter, and burn our candles at many shrines. In the pleasant realms of poetry no liveries are worn, no paths prescribed; you may wander where you will, stop where you like, and worship whom you love. Nothing is demanded of you, save this, that in all your wanderings and worships you keep two objects steadily in view—two, and two only, truth and beauty."

The frequent references to liberality in dealing with the religious opinions of others lead us to hope that Mr. Birrell, if anybody, is the man to pilot the Education Bill through the rocks and quicksands of the claims of rival religious bodies.

BY MANY HANDS.

"Quot homines, tot sententiæ."

N.U.T. NOTES.

THE proceedings at the Scarborough Conference will, so far as the *Private* Sessions are concerned, transcend in interest any previous *séances*, whilst the importance of the Public Sessions will necessarily depend on the appearance (or otherwise) of the great Education Bill, prior to Easter week. The usual arrangements have been made with the various railway companies, which have consented to issue return tickets at single fare and a quarter for the double journey to members and others attending our professional durbar. This year the tickets will be issued on and after Wednesday, April 11th, and will be available for return on any day not later than Monday, April 23rd, so that visitors may, if they please, spend twelve days at the "Queen of the North." An Inaugural Reception of the Members of Conference by the Local Conference Committee will take place on Thursday, April 12th, in the Reception Room at the Old Town Hall from 8 to 10 P.M., and will doubtless be well attended by the "early birds" who annually migrate to the Conference town at the first possible moment. Good Friday is a *dies non*, visitors making their own plans for the day; but on Saturday, the 12th, excursions by "road, rail, and water" are announced, and the Reception Room is open from 11 A.M. to 10 P.M. The official proceedings are timed to commence at 10.30 A.M. on Easter Monday—half-an-hour earlier than last year—at which hour Conference will be welcomed by the Mayor and other representative citizens. According to custom, they will be thanked by the retiring President, and immediate ex-President, and Messrs. John and Sharples may safely be relied on to uphold the dignity and honour of the Union at this juncture. The exchange of Presidents will see a "Yorkshire President for a Yorkshire Conference," and my old friend, Mr. T. P. Sykes, must be prepared for a veritable ovation. Reception of deputations is the closing business of the inaugural sitting, and this year, for the first time, it has been found necessary to append the significant words: "These are now so numerous that it is necessary to restrict the speeches to one on behalf of each body, and to a period not exceeding five minutes." Even if this friendly hint be generally accepted, the luncheon hour is likely to be unconscionably delayed, though I trust we are not drifting back to the ante-Bristol days, when the opening Session was a literal "trial of endurance."

Ready for Scarborough.

THE second Public Session is really an assembly for the President's Address. The adoption of the Standing Orders usually gives rise to a little preliminary sparring 'twixt floor and platform, though since Manchester, when some wicked members of the "Young England" party delayed the proceedings for about two hours, these Standing Orders have quickly been rushed through. For some reason or other, which I have never been able to fathom, a junior member of the Executive is invariably put up to move them. It's all right if he does not suffer from "stage fright" or any similar complaint; but I should have thought a safer plan would have been to entrust them to some "old Parliamentary hand," skilled in debating power, and knowing something of the temper and atmosphere of Conference. We may anticipate from Mr. T. P. Sykes an address worthy of the great occasion, though, at the time these "Notes" are being penned, it is uncertain whether it will fall to him to forecast an Education Bill, or deal with one actually before the country. The subjects chosen by a ballot of the local associations

The Public Sessions.

during the third and fourth Public Sessions deal with such diverse topics as the Amendment of the Education Acts, Salaries of Class Teachers, Male Supplementary Teachers, Size of Classes, Register of Teachers, Discipline in Schools, Examination of Scholars, Syllabus of Work. In these columns, a year ago, I (perhaps presumptuously) hazarded the opinion that "the arrangement of the business of the Public Sessions ought to be entirely in the hands of the Executive," owing to the thoroughly unsatisfactory result of all previous *plébiscites*. The Llandudno Conference made a considerable advance in this direction by agreeing that the "*first* subject at each of the Public Sessions of Conference be selected by the Executive," and in pursuance of this privilege, they have chosen the Amendment of the Education Acts, and the Size of Classes to have the *pas* on Easter Tuesday and Wednesday, respectively. Dr. Macnamara, M.P., will, appropriately enough, have charge of the first-named subject, whilst no better introducer of the "Size of Classes" could have been chosen than Mr. A. R. Pickles, B.A., Chairman of the Education Committee. Votes of thanks to the local officials and to all who have in any way assisted to make the Conference a success will be moved from the Chair at 12 noon on Wednesday, half-an-hour before the time fixed for the closing of the Session.

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The Private Sessions.

I HAVE already referred to the important and absorbing nature of the business to be transacted at the various Private Sessions. So momentous, in fact, are the issues to be determined at Scarborough that the Executive have—wisely, I think—decided to hold *three* such sittings, viz., on Tuesday and Wednesday from 2 to 5 P.M., and on Thursday morning from 9.30 to 11, and even with an extra Session, it is doubtful whether all the vital matters will be settled. Unfortunately, for a number of years, for causes well known to my readers, these Private Sessions were singularly unpleasant affairs; but a new era seemed to dawn at Llandudno, and I trust we have now seen the last of aspersions on the personal honour of *anybody*. A proposal to increase the salary of the General Secretary, as from 1st January 1905, to £550, and to further augment it to £600 per annum, as from 1st January 1906, will probably be accepted unanimously, and with enthusiasm; for Conference is never slow to recognise merit and real worth. Since Mr. Yoxall took the helm, the Union has literally never looked back. Its membership has been first doubled, then trebled since his appointment at Leeds in 1892; and during the past fourteen years his fertile brain has continually suggested new methods of enlarging the Union's influence and utility, whilst his watchful eye has been prompt to observe and seize every opportunity of furthering the best interests of his rapidly increasing *clientèle*. Some day I may find time and space to indite a panegyric on the popular member for West Nottingham; but, meanwhile, let this brief commendation serve. The Examiners of Accounts will probably have but a short innings, and the discussion on the Financial Position of the Union will most likely arise on the Executive's Special Report to Conference. I foresee a titanic struggle over the appointment of a Secretary to the Examinations Board, and the proposal is certain to be stoutly fought by the section ready to "close down" everything which does not show a monetary profit. However, if Mr. T. F. Bowers, B.A., be happily restored to complete and perfect health by Easter Tuesday, and Mr. Walter Shawcross, B.A., be in his usual "form," the issue should not be long in doubt. Superannuation of Teachers will easily fill the bill for the rest of the first Private Session, and I shall not be astonished to see the Executive's proposals still before Conference on Wednesday afternoon. I may be prejudiced in their favour, of course; but I must add that the more they are criticised and discussed, the sounder do they appear to me. The suggested increase of subscription for a Sustentation Fund will necessarily evoke prolonged and most serious consideration, and its acceptance or rejection is quite "on the knees of the gods." After this matter is decided, then the Constitution will once again be in the melting-pot, and though I'm no iconoclast, I do wish every success to Mr. C. W. Hole and his 36-membered scheme. If the motion empowering the Executive to make a levy be reached at all, I shall be much surprised; and I forbear to mention all the other important matters printed on the Agenda, for there is not the remotest chance of their being discussed.

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AS it is more than possible that the pending Executive Election may be the last under the system inaugurated at Swansea, I append some figures relating to the whole series of elections since the country was divided up into districts:—

Year.	Number to be Elected.	Number of Candidates.	Average Number per District.	Districts with No Contests.	Old Members Unseated.
1898	36	86	7·2	...	3
1899	36	58	4·8	2	4
1900	36	60	5·0	1	4
1901	36	52	4·3	2	2
1902	38	56	4·7	2	2
1903	41	59	4·9	...	3
1904	42	58	4·8	4	2
1905	44	65	5·4	2	4
1906	46	63	5·2	3	...

The Pending Executive Election.

North England, North Midland, and South London are the constituencies whose members are, this year, indulged with a "walk over." In Lancashire and Yorkshire the retiring members are opposed by Messrs. Sidebottom and Page, neither of whom has any chance of success. Miss Dix will probably poll well in the South Midlands, though her hour has not yet arrived. In East Anglia Mr. F. B. Gale is making a determined effort to regain the seat he lost last year, and his success would be very popular in many quarters. The opposition to the old members in South England need not be regarded seriously, but, in West England, I should be delighted to see Mr. Egbert Ruse gain the seat vacated by my good old friend, Mr. W. J. Prosser. In Wales there are seven candidates for four seats, and I expect to see Mr. Evan Davies, of Barry, returned as a colleague of Miss Williams and Mr. Rhys Nicholas. To foretell the fourth successful member is beyond my powers. "No change" will probably be the result in North London, although the presence of the veteran, Mr. E. R. Phillips, in the field, will lend an element of interest to the contest. In East London Mr. C. W. Crook is attempting to win

back the position he occupied from 1903–5. His success is problematical indeed, but should he be returned, his victory (like Mr. Gale's) will be very popular with his former colleagues. To sum up: the most exciting contests will take place in East Anglia and East London, where "anything may happen." I do not anticipate more than *two* of the present Executive suffering defeat at the polls.

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The Executive's Report.

THE thirty-sixth Annual Report of the Executive to Conference gives, in outline, the work done by the various standing committees, and is a production worthy the thoughtful and earnest consideration of every member of the Union. Reference is properly made at the outset to the return of three members of the Union—Sir George Kekewich (our only "honorary" member), Dr. Macnamara, and Mr. Yoxall—to the new Parliament, and the non-success of Mr. Gray is naturally sincerely deplored. Death's cold hand has been busy during the past year, claiming as its victims the gentle J. R. Langler, a founder of the Union and President in 1881–2, and sturdy John Wright, one of the most talented of the younger series of Executive members. From the Organisation Committee's section of the Report, I observe that there are now 56 County Associations, 486 Local Associations, and 57,578 members in the Union, the increase in membership during the year being thus 3571. The whole Report fitly concludes with the heartiest thanks of the Executive to the "local officers, members of Committees, collectors, Parliamentary correspondents"—in fact, to all those energetic men and women upon whom falls the local work of the various branches of the Union.

* * *

The "B. and O." and the "T. P. S."

EVERY year the close connection between the Union and its ancillaries, the Benevolent and Orphan Fund and the Provident Society, is evinced by the inclusion of lengthy paragraphs concerning their work in the Report of the Executive to Conference. With genuine regret, I observe that there has been a most unwelcome diminution in the income of the "B. and O." Fund for the past year, the amount received as subscriptions having fallen from £18,520, 1s. 11d. for 1904 to £16,966, 17s. for 1905—decrease, £1553, 4s. 11d. Almost as if to accentuate the diminution in income, the amount expended in benefiting needy and distressed teachers, teachers' widows, and teachers' orphans, has largely *exceeded* that of any previous year. The amounts so expended for 1905 and 1904 respectively are £17,127, 9s. 11d. and £14,346, 18s. 5d. — increase, £2780, 11s. 6d. The moral of these sets of figures is obvious. Associations must work much harder during the current and succeeding years if the sacred cause of charity is not to suffer. The "T. P. S." goes on from strength to strength, last year admitting 2469 new members, a "record" for this most useful handmaiden to Union activity. At a time when so much is being said and written regarding return of Superannuation Premiums, the Executive are wise in recommending all teachers to take advantage of the scheme framed for their benefit, whereby the money paid to the Government, as well as the premiums paid to the Society, are returned in the event of death occurring before 65 years of age. *Verb. sap.!*

A. C.

THE COMING CONFERENCE OF THE N.U.T. AT SCARBOROUGH.

THE PRESIDENT-ELECT:

Mr. T. P. Sykes.

YEAR by year the National Union of Teachers advances steadily in numbers, prestige, and importance, and, *pari passu*, the dignity, responsibility, and consequence of its chief administrative officer necessarily increase. A year ago a former President—one therefore in an exceptional position to state his facts accurately—wrote a pithy compendium of the qualities requisite for a successful President in the columns of this journal, and without hesitation I venture to reproduce a portion of his striking *conspectus*. "The chief officer of a Union now well over 50,000 strong," wrote he, "must necessarily be a many-sided man. He must be sufficiently hardy physically to undertake long and tiring railway journeys to the very extremities of the country, in order to take part in educational demonstrations; he must be robust enough to withstand the strain of lengthy and occasionally weary Executive meetings; he must be ready at every moment to state the position of the Union on any educational or professional question; he must be cognisant of the domestic work of the N.U.T. down to its minutest detail; he must be ready to bear his part bravely and worthily in connection with the multitudinous social functions organised by the local associations; he must be prepared, during his year of office, to indite replies to thousands of correspondents (the vast majority of whom he does not, and cannot, know) requiring information on every conceivable subject.

"And during Conference week what a truly colossal task is his! From the eve of Good Friday until the end of Easter week he is literally the cynosure of every eye. His presidential address, sent in advance to every journal of repute in the United Kingdom, must not only palpitate with interest, but be up-to-date, pungent, critical, exhaustive, and a statesmanlike pronouncement on the urgent educational questions of the moment. In the chair of the Conference he must be ever on the *qui vive*, prompt to decide on delicate and ticklish 'points of order'—those eternal nuisances!—tolerant, yet not too indulgent to the bores, and ready at any second to deal kindly with the eager seeker after truth. Above all, he must be scrupulously fair, the guardian of the rights of minorities, impressive and dignified from start to finish, and gentle to a fault towards each of the two thousand delegates. He must appear, if only for the briefest space, at every function of the week, and make short, pithy speeches wherever he goes. Twenty-five or thirty addresses are the minimum which falls to his lot. Finally, he must have the good fortune and felicity to be supported by a helpmate whose presence will lend grace at every turn, and who will be responsible for many charming little acts during the course of Conference week."

Apropos of the presidential address, it is interesting to note that at least *two* of Mr. T. P. Sykes' predecessors in office, having prepared their prolations with loving care, and polished their studied pronouncements with apt quotation and pointed epigram, worthy the deliverance of a Cicero or Demosthenes, had incontinently to destroy their treasured productions in order to deal with Education Bills presented to Parliament

on the very eve of Conference. The 1902 President was compelled to rewrite his speech and give prominence to the epoch-making measure which subsequently became the 1902 Education Act, after hearing the first reading debate in the House of Commons, and without actually seeing a copy of the Bill itself; whilst his distinguished precursor, Dr. Macnamara, M.P., was in even worse case, having a day less in which to prepare for his most trying ordeal. This "appreciation" of the incoming President being written perforce some weeks before Easter, I can only express the hope that the portentous and significant words of the King's Speech—"A Bill will be laid before you at the earliest possible moment for amending the existing law with regard to education in England and Wales"—will not entail undue anxiety on Mr. T. P. Sykes, but that he will, on Easter Monday afternoon at Scarborough, be able to give his eager and expectant audience the fruits of many years' wise, intelligent, and penetrating thought and reflection.

Whatever may happen, however, 'twixt now and Easter, members of the Union need have no misgivings, for the calibre and worth of the popular Bradford gentleman have been proved on many a hard-fought field. Bradford was (if my memory serve me correctly) actually *the first* city whose teachers, realising the value of having a mouthpiece of their own on the local education authority, boldly invited one of their number to relinquish his profession and become a candidate for the School Board. They formed a Teachers' Representative Association, raised large funds for the support and election expenses of their delegate, and had the satisfaction of securing his triumphant return, until the 1902 Act ruthlessly swept the School Boards out of existence. They knew full well that the only effectual check to a bureaucratic educational administration was the presence in the council chamber of a man who knew as much as the officials, both of the local facts regarding education and the *technique* of the profession, and who could not be "bowled out" by a simple and apparently ingenuous explanation. In this struggle for professional freedom, Mr. T. P. Sykes naturally took a commanding position, becoming President of the Teachers' Representative Association, and, through all the arduous election contests, nailing his colours to the mast, and occupying a prominent place at the teacher-candidate's side. His complete and thorough knowledge of every phase of the education question enabled him to render invaluable service at public meetings, and, though a well-circumstanced teacher himself, he (unlike, alas, so many of the "aristocracy" of the profession) evinced his sympathy with *practical* Unionism by generous financial aid to the Association. Probably one would not go far wrong were one to assume that of all the magnificent services rendered to education and his profession, Mr. Sykes is to-day most proud of the work he did in connection with the Bradford Teachers' Representative Association.

For two-and-twenty years he has been a member of the Union, and during this lengthy period has held practically every post at the disposal of his fellow-teachers, and more than justified the high confidence reposed in him. In addition to the positions held in connection with the Representative Association, he is a Past-President of the West Yorkshire District Union—certainly one of the most vigorous and progressive of all such organisations for many years—and a member of the executive of the Half-Time Council. Mention of the Half-Time Council will bring back to the recollection of old Conference *habitués* the titanic duels once fought between Mr. Sykes and that brilliant debater, Mr. Richard Waddington, on the question, Age only *v.* Age and Attendance, as the qualification for Labour Certificates and Exemption from School. It is no disparagement to the President-Elect to relate that he was no match in debate for the Bolton protagonist, though personally I always shared Mr. Sykes' views. To-day they would, I feel confident, be accepted by both Conference and Executive with practical unanimity, so greatly has opinion altered during the past ten or a dozen years.

For eight years he has been a leading member of the Executive of the Union, and from the earliest of his years of office was prepared to fight his hardest for what he thought the right course, even though he stood alone. I remember particularly how, some six or seven years ago, he strongly opposed the erection by the Executive of a school somewhere in the south of England, contending that it was no part of the Union's duty to save the pockets of the local ratepayers, even in order to vindicate a great principle. At the close of a stormy discussion he found himself in a minority of one; though, had his counsel been followed, the Union's exchequer would to-day have been better off by hundreds, nay thousands, of pounds, incurred on behalf of one who was quite unworthy of any confidence. For five and a half years Mr. Sykes was either Chairman or Vice-Chairman of the Tenure Committee, being called on to preside over its deliberations when Mr. T. H. Jones was appointed an Inspector by the late London School Board.

No official position at Bolton House is quite so exacting as that of Chairman of the Tenure Committee, necessitating, as it does, in the course of a year, hundreds of hours' travelling in frigid and draughty trains, many a lonely drive, and many dreary tramps; but Mr. Sykes never shrank from what appertained to his high and responsible office. With him 'twas ever a case of *noblesse oblige*, and he undertook, oftentimes at very short notice, scores of investigations and delicate inquiries on behalf of suffering and oppressed fellow Unionists. In the dual capacity of investigator and mediator, Mr. Sykes visited Yorkshire, Lancashire, Cheshire, Wales, Lincoln, Durham, Westmorland, Cumberland, Norfolk, Suffolk, Derbyshire, Nottinghamshire, and Hampshire, and to his influence and tact many a much-threatened teacher owes the retention of his position to-day.

Every branch of the Union's work has benefited from his unremitting labours. The noblest phase of its activity—the Benevolent and Orphan Fund—has always appealed to him very strongly indeed, and by means of school concerts (with their incessant and almost interminable labours) large sums of money have been raised by the Great Horton Council School, of which he is the talented and successful headmaster. (*Par parenthèse*, I may remark that I have been in scores of schools during the past five-and-twenty years, but I can honestly say that the most delightful hour I ever spent in any single establishment was from nine to ten, one October morning, when observing Mr. Sykes' human and happy children.) He is a life member of the "B. and O." Fund, and also an annual subscriber to the Church Benevolent Fund. The Teachers' Provident Society, which enables teachers to

do for themselves what the "B. and O." Fund allows them to do for others, has found in Mr. Sykes one of its most enthusiastic supporters, and for many years he acted as local secretary of the Bradford branch.

Like every public man, he has a "programme"; and readers of the *Practical Teacher* will probably be interested in conning the list of reforms Mr. Sykes hopes to see accomplished. "He goes straight"—the words are those of his own Vice-Presidential electoral manifesto—for

(1) A Professional Code of Honour.
(2) A National System of Education, with the Abolition of Religious Tests for Teachers.
(3) Reform of the Training College System.
(4) Better Recognition of Certificated Class Teachers as to Remuneration, Fuller Powers, etc.
(5) One Register for all Teachers.
(6) Improved Superannuation Act, Optional Retirement, Return of Premiums, Increased Subvention by State.
(7) Abolition of Half-time Attendance, Raising of the Age for Leaving to 14 years.
(8) Better Conditions of Work in Rural Schools, Salaries, Staffing, etc.
(9) Smaller Classes, Increased State Grants to all Schools.

If Mr. Sykes, when he decides to lay aside his armour, has the good fortune to see a moiety of the above reforms effected, he will be able to go into retirement a happy man.

He is an accomplished musician, and has lectured on "Practical School Music," to the delight and profit of hundreds of teachers from Land's End to Berwick-on-Tweed. At a time when there was a grave risk of purely educational questions totally disappearing from the purview of professional organisations, I consider Mr. Sykes rendered a national service in keeping one important part of the school curriculum steadily before the teachers' notice. He is a lucid speaker, with a singularly taking style, and as a *raconteur* is quite in the front rank. He can pen an article, either grave or gay, with the same ease and felicity as he can speak; and possibly many of the older teachers may recollect chuckling (as I did) over the delightful humour of "Saved by a Blue Pencil" and "Moral Subtraction," which originally appeared in the *Teachers' Aid*.

Almost immediately after his accession to the Vice-Presidency, he was entertained at a complimentary banquet in his own city, when the Mayor of Bradford (in the chair), M.P.'s, H.M.I.'s, Education Committee members and officials, joined with his fellow-teachers in offering their felicitations on the distinction he had so worthily won. Reference to his charming wife was inevitable on this happy occasion; and certainly this monograph would be incomplete did not the writer bear his humble testimony to her genial hospitality and invariable kindness, which, on one occasion at least, were successful in warding off from him a serious threatened illness.

The venerable Brayton Baronet, in proposing the re-election of Mr. James William Lowther as Speaker, concluded his eulogium of the member for Mid-Cumberland by stating that he possessed three very excellent qualities or senses:—"First of all, he has the sense of proportion, which makes public life practicable; secondly, he has the sense of humour, which makes public life tolerable; thirdly, and best of all, he has common sense, which makes public life successful." It is because Mr. T. P. Sykes possesses the same three qualities or senses so abundantly that I venture to think he will make a highly successful President of the Union, knowing as I do, in addition, that whatever public offices he has been hitherto called to, he has filled with ability, with courtesy, and with dignity.

A. C.

NOTES FROM THE NORTH.

IN last month's Notes I referred to the fact that the question of tenure was coming prominently to the front in the work of the Institute. I was not able at that time to give particulars of any of the cases occupying the attention of the Emergency Committee. Since then, however, one of the cases has come into the public press, and from the point of view of the profession, a better case for the subject of tenure could hardly be found. As is usual, the case has occurred under a pentagonal School Board. In the last week of January, Mr. James A. Menzies, headmaster of Gartmore Public School, Perthshire, was dismissed from the position which he has held for nearly twenty years. The reasons for dismissal are in no way connected with his professional work or moral character. The school has always been considered one of the best in the district, and the reports of the Inspectors testify to the admirable work done by Mr. Menzies during all these years.

Tenure.

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I MAY be allowed here to give a short summary of the events prior to the dismissal. In October 1904, a vacancy occurred in the headmistress-ship of the school. The situation was advertised, and the Board drew up a leet of two. Mr. Menzies, on hearing of this leet, interviewed one or two members of the Board with a view to securing the better candidate for the school. The Board resented his interference, and appointed the teacher whom Mr. Menzies did not desire. His opposition was entirely disinterested, as he knew neither of the candidates, and it was only undertaken in the best interests of the education of the district. When the Inspector visited the school, he informed the Board that he thought this teacher was overweighted. In December last Mr. Menzies was asked to apologise. An apology was tendered, and read at the Board meeting; but it was refused on the ground that he had not apologised to each of the members on whom he had called. Between this time and the date of the meeting of the Board at which his dismissal was to be made, a meeting of the ratepayers of Gartmore was held. At this meeting there were two or three members of the Board present. One of them advised a deputation to the Board, with a view to a satisfactory and amicable settlement.

Gartmore Dismissal Case.

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A SMALL deputation was appointed, and a request made to the Board that an interview be given. The Clerk of the School Board, in answer to this request, appointed a meeting at seven o'clock on the evening of February 8th. Meanwhile the Board, with a lawyer present, met at 6.30, and there and then dismissed Mr. Menzies. They afterwards received the deputation at seven o'clock, and told them they had dismissed the teacher! Could discourtesy be carried further? There is to be a School Board election in

Later Developments.

the beginning of April, and the dismissal, of course, does not take effect until the 28th of May.

At a meeting of the Stirling Branch of the Educational Institute, of which Mr. Menzies is a member, a report of the case was given. I was present at the meeting, and a more harmonious yet more firm and determined meeting I have not before attended. From the report of the Convener of the Committee entrusted with the case, Mr. Ferguson of Alloa, it is evident that differences of opinion on church matters have accentuated the ill-feeling. It is not necessary to state at length what these differences are, but teachers may rest satisfied that in the matters under dispute Mr. Menzies has acted most honourably. No one ventures to suggest the contrary. The questions of unfermented wine at Communion, and of allowing his daughter to play the organ in the Parish or Established Church (Mr. Menzies is an elder in the United Free Church) seem to be the *fons et origo* of the quarrel.

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AT the various Branch meetings of the Institute references have been made to the case, and efforts are being made to get Parliament to take up the matter. The Scotch Education Department has in the first instance been approached, inasmuch as the dismissal actually took place over the interference of Mr. Menzies in the selection of a teacher for the school, and the consequent report of H.M. Inspector on the work of the Infant Department. It may be that the Department will answer that it has no powers to intervene, in which case the Secretary for Scotland will be approached, with a view to interfering in this particular case, and of introducing this session a one-clause Bill dealing with tenure. There can be little doubt that if the recent Bill had passed, this dismissal could never have happened. But it may be that this case will be most beneficial to the question of tenure. The Government must soon be made alive to the fact that the tenure of teachers is at present most insecure, and that a right of appeal should be given to a tribunal above and beyond the petty jealousies and local squabblings of the village or parish.

Results.

* * *

SINCE writing the above, one of the members of the School Board has written defending their action in dismissing Mr. Menzies before they heard the deputation. The reasons alleged are that there were some non-ratepayers present at the meeting that appointed the deputation, that some one called the Board the most ignorant in Scotland, that another person said the Board was a set of noodles, and that a member of the Board was hissed as he left the meeting. The member writes as follows:—"Was it to be expected that the Board would receive some of these men courteously, and sit round a table and try to come to an amicable settlement of the dispute with Mr. Menzies? He had been offered every chance of ending the dispute, but persisted in refusing to comply with the demand of the Board for a satisfactory written apology to the members on whom he had called, the Board being the sole judge as to whether the apology met their demands or not. The Board was appointed to administer the educational affairs of the district, with power to engage or dismiss servants on what the Board considered sufficient cause, without being dictated to or advised by any deputation or trades'-union. And further, the Board looks upon the interference of the Educational Institute as an attempt to prevent its using the power conferred upon it by the Legislature, and believes that my Lords of the Education Department will have something to say to the Educational Institute for the conduct of its chief official. The Board considers the foregoing a sufficient justification for not receiving the deputation before it dismissed Mr. Menzies." With that I leave the case for the present.

Defence by one of the Members.

* * *

THE draft regulations for the preliminary education, training, and certification of teachers for various grades of schools have been the subject of considerable discussion both at School Board and Educational Institute meetings during the past month. From School Boards they have met with a somewhat mixed reception. Some have seen in the abolition of the pupil teacher system much to cavil at, while others have viewed it with considerable approval. On the whole, subject to certain modifications, the teaching profession has expressed its acceptance of the regulations, inasmuch as they are fitted to secure the thorough training and equipment of all classes of teachers, and are intended to raise the profession, while at the same time they remove all the back-doors of admission. There can be little doubt that a truly progressive spirit pervades the regulations, and I am strongly of opinion that they will do much to improve the profession and make it more attractive. I do not mean that the regulations will flood the profession. For that purpose more things are needed than a satisfactory method of training. If the ultimate prospects of better salaries, more reasonable tenure, and more adequate superannuation allowances are not secured, regulations, however perfect, will do little to advance the profession.

The Training of Teachers.

* * *

AS I hinted in last month's Notes, the regulations make a fatal mistake in setting up distinctions with regard to the certificates necessary for primary and secondary schools. The Institute, with reference to this point, has proposed, "That all candidates for the higher certificates should be required as a preliminary to take the general certificate, and thereafter to add the special qualifications for the higher certificate." The traditions of Scottish education are decidedly against any such distinction. At present the teacher in a primary school is qualified to take a post in any secondary school, or even to become an Inspector. Why, then, should the unenviable cleavage be introduced? In the interests of the secondary teacher, too, the distinction is to be regretted. The supply of secondary teachers would be greater than the demand, for at the present time many secondary teachers obtain situations in primary schools. If these regulations come into force this will be impossible. Therefore, while the regulations secure that secondary teachers should be trained, they will limit their prospects.

Modifications Demanded.

IN many of the discussions that have taken place one or two very important points have been overlooked. In the first place, many of those who have advocated the continuance of the present pupil teacher system have not taken cognisance of the fact that the system that now exists is wholly different from that which prevailed ten or twenty years ago. In all our cities, and in many of our large centres, Pupil Teacher Institutes have been set up, so that the pupil teachers receive their education for half the day, and their practical training on the other half of the day. In this way we have already paved the way for the regulations. In the second place, it has been almost entirely forgotten that there is now a preliminary examination to be passed by all who essay to enter the University. Ten years ago, all who wished to go to the University could go without passing any such preliminary. The examination is becoming harder, and as a result the pupil teachers must be educated to the standard of the University Preliminary. Can this be done if more attention is not given to the preliminary education of the future teacher?

Certain Points Overlooked.

IN all probability the regulations will be postponed till we have the introduction of an Education Bill. It is a pity in many ways if such takes place, for we are simply delaying an improvement which must come. There is no time like the present, and I do not see that much hardship would be entailed on School Boards by the passing of the regulations. The need for trained teachers is clamant, and School Boards who are willing to exploit pupil teacher labour at the expense of the education of the pupils do not deserve a great deal of consideration. Had the Department last year introduced into the Code an article to the effect that pupil teachers would not count on the effective staff of the school, much of the opposition to the draft regulations would never have been heard of. Political influence in not a few quarters is being exerted to defeat the regulations. I have even heard of School Boards petitioning their members of Parliament against the abolition of pupil teachers, and yet for more than twenty years they have not had a pupil teacher in their schools.

Postponement.

AT present the Institute's energy is all taken up with tenure, superannuation, and the training of teachers. It was hoped that they might have had an opportunity of approaching the Scotch Office on the former of these, but they have not been able to secure this—one more argument, if such were needed, for the Institute having a member of Parliament of its own. Gartmore will, however, do much to hasten legislation with regard to tenure. Already indications are not wanting that this subject will be immediately attended to. It is not a day too soon. One of the most powerful deterrents to men and women of ability entering the profession is lack of reasonable security of tenure. No one wishes the old *ad vitam aut culpam* tenure, but surely it is not asking too much to have *reasonable* security of tenure. R. D.

E.I.S. Doings.

UNTERM RAD (Under the Wheel).

VON HERMANN HESSE.

WITH the boldness which is characteristic of German criticism, the author of this novel sets himself to attack an evil of education in Germany which has not only survived the ineffectual criticism of medical men, but which has in later years become intensified.

Herr Hesse's novel has attracted very great attention in Germany. The leading reviews in the German Empire have criticised it in the weighty and exhaustive manner which is their characteristic, and independent thinkers on educational matters have acknowledged that the evil it denounces has a real existence.

It is the life story, culminating in tragedy, of a German schoolboy of exceptional parts, who is done to death by the mistaken zeal of father, teachers, and pastors. The story is simply told, without exaggeration or emphasis, and the lesson it enforces may be gathered as much from what the writer leaves unsaid as from what he says.

Hans Giebenrath is the son of a small merchant in a Suabian town, a man of narrow outlook, and a Philistine in the full sense of a term which is easily understood but difficult to define. None of his family had ever been suspected of genius, and on the hypothesis of heredity its existence in his only son could be traced only to the fact of the mother, whom he lost in infancy, being a woman of refined and intellectual temperament. The boy early gave signs of intellectual ability, and his docility and conscientiousness made him an easy tool in the hands of ambitious teachers. His earliest years were happy with his rabbits, his toys, his fishing-rod, his fairy tales, and with his imagination awakened and fired by old Liese's wonderful stories. But there comes a sudden change, and his childhood is rudely interrupted. Henceforth he must develop not as Nature intended, but in the way prescribed by the State for gifted boys.

The State offers a number of scholarships to enable talented children to enjoy the benefits of a College education. It is suggested to the child and to his father that he should try to obtain one, and both fall in eagerly with the suggestion. Success for the child meant eventually a reputation as preacher or professor; for the father it meant the satisfaction of being able to look up to his son with respect, and to talk of him with pride. But there was another category of persons interested in Hans' success. Never had a successful candidate for a State scholarship been sent up from the town school, and the chance of obtaining credit for Hans' success must not be lost. Little Hans, without a murmur, parts with his rabbits; no longer has he time to fish in the river or stroll in the woods. A period of exacting grind commences, and his life now is regulated by time-table, the details of which we give in Herr Hesse's words:—

"After school, which closed at four o'clock, followed the extra lesson in Greek with the Rector. At six o'clock the Stadtpfarrer was good enough to give him lessons in Latin and religion, and twice in the week after supper he went for an hour to the mathematical master for a lesson. . . . To avoid any possibility of intellectual overwork, and so that the soul should not be forgotten whilst the mind was being exercised, Hans had to go every morning, an hour before school com-

menced, to Confirmation class, where a refreshing breath of religious life was wafted into youthful souls by the stimulating process of learning by heart the questions and answers of the Catechism of Brenz."

To this programme must be added home-lessons lasting till ten o'clock at night, and on occasions up to midnight. The demands of the physical frame had to be satisfied with an occasional walk in the woods. The Rector insisted on this, and expatiated on the advisability of taking a book, and of experiencing how easy it is to learn in the open air.

The ultimate outcome of this overwork of a youthful brain seems not to have occurred to any of the persons most closely interested. Only Flaig, a shoemaker whose pietist tendencies made him an object of ridicule, denounced the cruelty of which young Hans was the unconscious victim. With but one exception, the teachers of Hans, right to the end of the chapter, are unconscious of the true cause of the failure of their high hopes and ambitions. As it is the humble shoemaker whose sturdy common-sense makes him realise the folly which is being perpetrated, so it is the humblest of young Giebenrath's teachers, whose name, with true artistic touch, our author does not mention, who realises there is something wrong in the whole system. Herr Hesse dwells with delicate irony on the way in which teachers' longing for professional success blinds them to the evils which they join in committing.

"It had been a heartfelt pleasure to the Rector to direct this worthy ambition, awakened by himself, and to watch it develop. Say not that schoolmasters have no heart, and are shrivelled and soulless pedants. No, when a teacher sees how a child's talents, which he has long and unsuccessfully tried to kindle into life, at last break forth, and he puts away his wooden sword, his sling, his bow, and his other childish playthings, how he comes to the front, how the chubby cheeks, under the influence of the seriousness of work, take on a more delicate, earnest, and almost ascetic appearance; how the boy's face becomes older and more intellectual, his glance keener and more confident, and his hand firmer, whiter, and steadier; his mind is penetrated with joy and pride. For it is his duty, and the task committed to him by higher authority, to curb and to root out the unregulated faculties and desires implanted by Nature, and to substitute for them the moderate ideals which are sanctioned by the State."

Under an entirely inelastic system of education, the teacher becomes simply a part of a machine of which the child is a more subordinate part. He looks upon the child from a merely professional point of view, and love for, and interest in the complex human souls committed to him, find no place. As his influence over the child is great, so is his responsibility towards it, and this responsibility increases in proportion to the weakness of the will of his pupil. It is because Herr Hesse is assailing the system and not the individuals who carry it out, that we owe him no grudge for his consistently ironic references to teachers. At the College to which Hans Giebenrath's success entitled him to go a student is accidentally drowned. The search party, who have recovered the body, are met at the entrance of the institution by the whole of the teaching staff.

"It may commonly be noticed that teachers always look on a dead pupil with far different eyes than on one who is still living. Despite the fact that they so repeatedly, and in the ignorance begotten by want of reflection, sin against life and against youth, they are for a fleeting moment convinced of the importance of both, and of the impossibility of restoring them."

But we are anticipating somewhat. Hans Giebenrath passes the examination week at Stuttgart, a week of doubts and fears and of feverish excitement. The result is a joyful surprise to him. He is second in the competition, and in his youthful egotism he exclaims that he could just as easily have been first had he tried. The holidays intervene before the commencement of the College session, and the boy's chain is loosed, but not for long. The Stadtpfarrer suggests a study of the Greek New Testament, a little more mathematics, and a commencement with Hebrew, and the dull grind of subjects, not all congenial, recommences.

Premonitions of nervous breakdown had shown themselves before Hans went to College. Persistent headaches and difficulty of concentration showed there was something wrong. At first all goes well at College, a little world the description of which forms about the best part of the book. Here Hans is at first repelled and afterwards attracted by a fellow-student Hermann Heilner, whose character is the very antithesis of his own. Heilner is something of a poet, impatient of control, and with a contempt for whatever is commonplace. He soon falls under the ban of the authorities, who cannot appreciate genius.

Heilner is sent away, and from this time he disappears from the story.

With Hans matters are going from bad to worse. His headache becomes more persistent, memory goes, and the overstrained faculty of attention at last breaks down altogether. He has to be sent home, to his father's horror and disappointment. He encounters no real sympathy. The head of the College is absorbed in the anxiety he feels at the way in which the authorities may regard the loss of two students in so short a time. Nor did he get any sympathy from the teachers whose hopes he had disappointed.

"The old Rector once or twice exchanged a few friendly words with him, and the Latin master and the Stadtpfarrer nodded to him benevolently in passing, but Hans was no longer a matter of concern to them. He was no longer a receptacle into which all manner of things could be stuffed, nor a field which could be planted with crops of various descriptions. There was nothing to gain now by spending any time on him.

Rest restores somewhat the lad's frame, but the taste for intellectual work and the power of study are gone. He tries to resume the childhood of which he has been defrauded, but the spell is broken, and the dejection which had been gradually invading him deepens. Then self-murder presents itself to his mind as the easiest way out of his troubles. At last old Giebenrath calls on his son to choose between the occupation of clerk at the Rathhaus, or being apprenticed to a mechanical trade. He chooses the latter, but the end soon comes, for he finds a rest in the cool waters of the brook on whose banks he had passed so many pleasant hours. At the graveside the old shoemaker, Flaig, points out to the sorrowing father the retreating figures of the Rector and the Latin master, who have attended the funeral. "There," says he, "go a pair of men, who have helped to bring him where he is." But even then the father, ignorant but well-meaning, does not understand.

There is much in this book to make teachers think. It is the work of one who knows what he is writing about, who feels deeply the existence of an evil he deplores, and who writes brilliantly and convincingly.

W. T. T.

OUR CLASSROOM AIDS.

THE SCHOOL AQUARIUM.

(*Continued.*)

BY P. HORN.

How to Maintain the Aquarium.

To maintain an aquarium in the best possible condition, one must be prepared to devote a certain amount of time and energy. This statement need not alarm the beginner. Five minutes' attention daily will suffice for a well-regulated fresh-water tank; marine tanks containing anemones and molluscs will probably require a greater expenditure of time.

Fish usually prove to be the most troublesome and unsatisfactory inmates of the beginner's aquarium, yet even these creatures can be kept in a thriving condition when once the novice has gained a little experience.

The Care of Fish.—Many of the directions given under this heading apply equally well to the generality of aquaria.

The Air Supply.—In the first place we must guard against overcrowding. Active gill-breathing creatures, such as fish and crustaceans from running streams, require a plentiful supply of oxygen; if too many are crowded together, they exhaust the supply faster than it can be replenished from the air around. They then evince their discomfort by rising in a body and gasping at the surface. Obviously there are two remedies, to take a few out, or to change or re-aërate the water. The former is the simpler method. A case in point for the guidance of the amateur in doubt:—

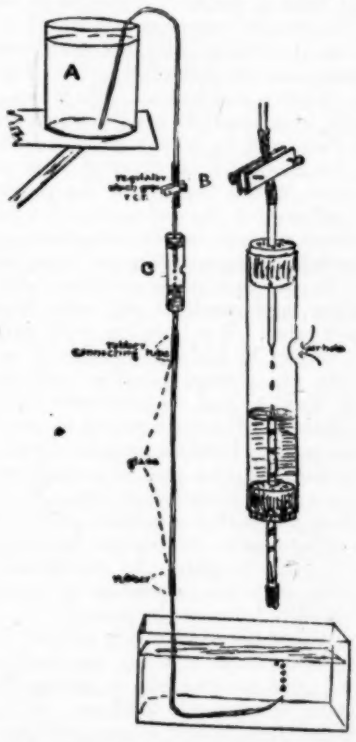
Half-a-dozen healthy minnows, now under observation, have been living in a tank containing two gallons of water since last August. In six months the water has been changed five times.

A convenient method of changing the water of small tanks when cloudy, is to place them beneath a tap and allow the water to run in gently until clear.

The importance of weed as an aërating agent cannot be over-estimated. If a small bunch of Anacharis be submerged beneath a glass funnel, over the end of which is placed an inverted test tube full of water, the quantity of oxygen given off in the course of a warm sunny day is astonishing. Readers are recommended to try this experiment.

A common method of aëration is to drive in the air bubbles by pouring water into the tank from a height above. This plan has the disadvantage of disturbing the arrangement of the weeds, etc., not to mention the alarming effect which it has upon the fish.

In last month's notes, brief mention was made of a simple aërating apparatus which has been successfully used in the Horniman and Stepney Borough Museums.



The apparatus comprises a reservoir and a syphon, which conducts water slowly through an arrangement somewhat similar in principle to the filter pump, well known to chemistry students. The diagram, which is more fully described in the Horniman marine handbook, is almost self-explaining.

(*A*) is the reservoir and syphon, (*B*) the regulator,

pinching the rubber connecting tube, consisting of two flat pieces of wood, which can be screwed nearer together or farther apart by means of small thumb-screws. Its purpose is to regulate the flow of water from the reservoir above, and it should be so adjusted that the water *drips* rapidly.

The next portion of the apparatus (*C*) is the most important. It consists of a four-inch length of ½" bore glass tube, through the side of which a hole has been filed. The bored corks at the end must fit tightly, and the fine-drawn pointed glass tubes should be so adjusted that the continuous drops of water from the upper strike upon the opposing point below. The succession of air-bubbles thus imprisoned are driven downwards, along bent tube (*D*), which is also drawn to a point at its lower end, and so into the aquarium.

The whole apparatus need not be more than four or five feet in length. The aërator (*C*) is placed nearer the reservoir to get the best results, and all the tubes should be kept clean, especially at the fine-drawn points.

By occasionally replenishing the reservoir from the aquarium, the apparatus will work for an indefinite length of time.

The whole apparatus is easily made by the aid of file and Bunsen burner.

Cost of rough materials, sufficient for the manufacture of half-a-dozen, ½" tube, 4d.; $\frac{3}{16}$" glass tube, 6d.; corks, 3d.; rubber tubing, 9d.; home-made regulators, 3d. Average cost of each, 4d.

Until they are thoroughly at home in the aquarium, it is advisable to supply the fish with a shelter to which they can retire for privacy. A flat piece of rock or a screen of weed placed well in the rear will answer this purpose. The minnows mentioned above, either rush headlong into a bunch of water moss, or skulk within the roomy old shell of a pond mussel.

The object of the sheet of glass, cut to fit over the top of the aquarium, as advised last month, is to prevent dust and soot from falling into the water. The glass cover should be slightly propped up in front, so that it slopes downwards towards the rear. The moisture which condenses on the under side is then able to run back into the aquarium.

Feeding.—Many people who keep goldfish appear to imagine that their pets are able to live indefinitely on what they can procure from the water.

If the fish are to thrive they must be fed, and fed regularly.

The mainstay of the aquarium-keeper is the Lumble worm.

The larger roach, dace, and perch feed readily on medium-sized worms broken into two or three pieces. Sticklebacks, minnows, and such small fish, are best suited with very small worms.

By way of variety, during the summer the finny tribe will appreciate maggots or "gentles," procurable at any fishing-tackle shop; in fact, the larvæ of the blue-bottle are usually taken in preference to worms.

Anglers are probably aware of the efficiency of bread as a bait, yet curiously enough, there appears to be a prejudice against its use in the aquarium. A very little bread given sparingly once a week in the form of a stiff paste (pellets) will be greatly relished by carp, roach, and minnows.

Vermicelli also has been recommended.

Under the old *régime* at the Crystal Palace, the fish in the aquaria were fed on finely-minced raw beef and horseflesh, and, judging from their appearance at this time, the food suited them.

The welfare of the tank depends largely on the manner in which the feeding arrangements are carried out.

On no account should uneaten food be left in the tank overnight. This is very important.

Organic matter quickly causes the water to become tainted and cloudy, and eventually results in disease. Feed sparingly and gradually once a day, and cease supplying food as soon as the appetites are satisfied. After the expiration of a few hours, the uneaten food must be removed with the dipping-tube and wooden forceps.

Further particulars of food and feeding will be given below under various headings.

Other Interesting Creatures suitable for the School Aquarium.

Newts.—These predatory amphibians require to be accommodated with a special reserved tank. Newts are persevering climbers, so in the first place we must if possible secure an aquarium with a close-fitting cover of perforated zinc. The interior arrangement differs from that of the ordinary type of tank. Occasionally, in a state of nature, newts forsake the water; hence the amateur who wishes to study the habits of his captives will provide them with a small island or shelving platform of rockwork, on which they can clamber.

The depth of water need not necessarily be great; from four to six inches is sufficient.

Once a day, feed sparingly on pieces of worms, and, in the case of the Great Newt, scatter the food in order to avoid contention.

On no account should the pink-striped and odorous brandling worm (usually found in manure heaps) be given.

During the month of May, the plump, crestless female newts deposit their spawn, and to this end, they will readily avail themselves of a convenient bunch of Anacharis or Water Buttercup.

Young newts are easily reared, providing the right food is supplied to them, and they are much more interesting than the ordinary frog tadpoles. Remove the weed directly a sufficient quantity of spawn has been deposited, and place in a large jar aquarium, together with a further supply of weed. Fill the vessel with pond water (this usually contains numbers of water-fleas, the staple food of the young newt), and stand it on a warm, sunny window-ledge until the active little tadpoles appear.

Henceforth, from time to time, it is necessary to substitute small quantities of fresh pond water. Should a large spare aquarium be available, a supply of water-fleas and other minute creatures can easily be bred for the maintenance of the young newts during winter. When the latter are a year old, they may safely be supplied with gnat larvæ (blood-worms), and eventually with tiny garden-worms.

Young Axolotl tadpoles can be reared in a similar manner, providing sufficient food is procurable.

Frog Tadpoles.—The habits of these creatures are so widely known that they may be dismissed in a few words. Furnish the tadpole tank with a shelving bank as advised for newts, and place a variety of weed in

the aquarium. When a fortnight old, feed with pieces of worms and meat, otherwise the tadpoles will never reach maturity. Remove to a fern-case, or another aquarium, directly they quit the water as frogs. A good supply of tadpoles is useful for the purpose of feeding newts, beetle larvæ, and dragon-fly grubs.

Crustaceans.—Crayfish require shallow water, with a gravelly bottom, and a little rocky cavern in which to hide. Keep the water well aërated, and feed the animals twice or thrice weekly with pieces of meat, fish, and worms.

The smaller crustaceans, such as water-fleas, water-shrimps, and the asellus or aquatic hog-louse, are natural scavengers. They will live in harmony in a weedy tank, providing they receive animal matter occasionally; but it is not advisable to introduce the last-named creature into the company of very young tadpoles.

Water Spiders.—Two spiders are sufficient for a small tank. Before introducing, we must be certain that the water contains plenty of small crustaceans and other minute life, together with a goodly bunch of weed. Occasionally renew the stock of small deer, and vary the diet with pieces of living worms.

Beetles.—Most of these are predatory and require special accommodation.

The Great Water Beetle (Hydrophilus), a clumsy black fellow, is herbivorous. He is fond of water-cress, but will not object to an occasional piece of worm.

Dytiscus marginalis, which has a *yellowish border* to the wing cases, is purely carnivorous; so too are the Boatmen and Colymbetes beetles. If they are not supplied liberally with animal food, they will invariably indulge in cannibalism.

In the larval stage, the Dytiscus must be isolated in *solitary* confinement, and supplied with worms and tadpoles *ad lib.*

Dragon-fly Larvæ.—The same course of diet will suit the hideous grub of the dragon-fly. Plant a few dry twigs or a bunch of rushes so that the tips project above the surface of the water. At the Stepney Museum last year several larvæ were successfully reared to maturity.

Caddis Worms.—The larvæ of the Caddis-fly, of which there are numerous species, are mainly herbivorous; but if the aquarium-keeper places too many together in one tank, their numbers are apt to decrease in a very suspicious manner. They are seldom reared to maturity. Provide them with as many varieties of water-weed as possible, and occasionally give pieces of dead worms.

The writer will be pleased to supply any further information in next month's issue. At the time of writing (March 1) the male newts in an indoor aquarium are just beginning to assume their ornamental crests.

Next Month—"A May-day Ramble."

The Scarborough Conference.—Although the Conference this year falls rather late in the month, we have made arrangements to present our readers with a full account of it in an eight-page supplement.

Kensington Vacation Course for Teachers.—Our readers may be pleased to know that the Frœbel Educational Institute has decided to hold another vacation course this year. Full particulars can be obtained of the Secretary, Miss M. E. Finday, 7 Hadleigh Road, Leigh Village, Leigh-on-Sea.

THROUGH INDIA WITH T.R.H. THE PRINCE AND PRINCESS OF WALES.

THERE was a long and rather monotonous journey of over twenty-four hours to bring the Royal party from Lucknow to Calcutta. The lower Ganges basin is almost perfectly flat, dropping imperceptibly to the sea-level, that is, to the immense swampy delta of the Ganges—a vast mass of mud gradually deposited till it rises above the sea and steadily pushes the coast-line further south. With considerable heat even in the winter, and much rain in the very hot summer, this mud is the source of dense vegetation of many varieties. So dense is it that the traveller approaching Calcutta

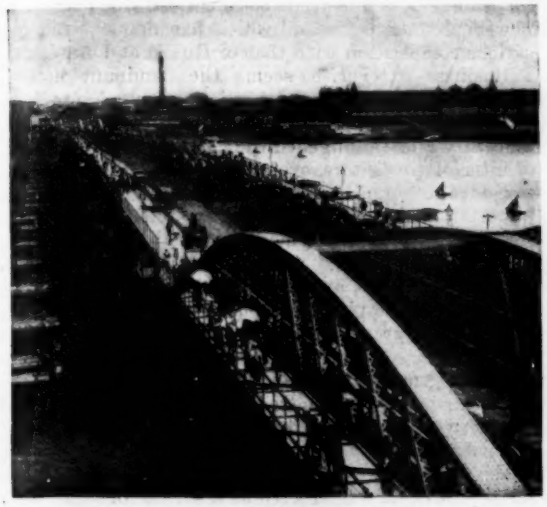
STREET IN CALCUTTA.

by train can see only a few yards on either side of him, and the ruined huts and houses dotted along the route seem to have had the life choked out of them by the rank growths, and are indeed half-buried. The railway runs on the western side of the Hugli and to the station at Howrah, the comparatively small suburb of Calcutta on the right bank of the river. From the railway jetty at the riverside, the Prince and Princess went by steam launch a little way down the river, along by the great "Maidan," which is an open park-like space fronting the river for two miles on the city side, as far as Prinsep's Ghat, a huge yellow landing-place, now the scene of a great reception. This journey across and down the river had two advantages: it took the place of a drive through some rather narrow and squalid streets, for most of Calcutta is far from lovely; also it afforded a good opportunity for viewing the Hugli and its shipping, for on the existence of this river and its traffic the growth of Calcutta has been based.

In replying to an address of welcome, the Prince said: "There is nothing, perhaps, in the whole of India more typical of the relations between the British and the nations of India than Calcutta, which has grown from a river swamp to be the second city of our Empire." Calcutta, which now has a population of nearly one million people, owes its existence to the trade which was started on a large scale by Europeans and is rendered possible by the security brought about by the British Government.

The city is some thirty miles up the Hugli, and is the natural port of the enormous and extremely pro-

ductive regions of the Ganges and Brahmaputra valleys. These rivers form excellent means of transport, and they are supplemented by great railway systems. The river is crowded with all kinds of boats and ships, bearing timber, indigo, jute, tea, grain, and other commodities of the export trade, and returning with the



BRIDGE OVER THE HUGLI, CALCUTTA.

imports bought by these goods. The railways, too, carry many kinds of products, but especially the more costly articles, such as opium and silk, which alone can bear the heavier cost of transport.

Calcutta is now becoming a manufacturing centre; cotton, paper, and especially jute manufactures are carried on, and this development is aided by the fact that the most important coal mines of India are on the edge of the Ganges delta, and therefore not far to the west of Calcutta. Then the position of Calcutta as the seat of the central Government has attracted to it a large population, but this factor is lessened by the unhealthiness of the city for Europeans. It is, indeed, only in the winter that the Viceroy transacts his business here, and the Europeans generally live in Calcutta as little as possible. They do not look upon the city as their home—they live as often as they can in healthier and cooler places, and return to England from what they regard as exile.

After the Prince had been received at the Ghat, he drove across the Maidan to Government House, the official residence of the Viceroy. This is a reproduction of an old English palace, and, like most of the other important buildings of Calcutta, does not suggest India, except perhaps in the surrounding trees and gardens. The very buildings of the city proclaim its European origin, and their appearance is in strong contrast with the Mohammedan architecture of the cities previously visited.

There are necessarily few old historical associations with Calcutta. The "Black Hole" of infamous memory has disappeared, and there is some uncertainty even as to its site. Fort William seems out of date—a fort in this place appears superfluous, for the enervating climate has produced a weak race, and the native population, though teeming, seems servile and incapable of rebellion even if it wished.

The Maidan is a redeeming feature of Calcutta in the eyes of the Englishman. It contains a splendid drive, which is the fashionable promenade of the city, and so the Maidan might be called the Hyde Park of Calcutta. But it also contains a racecourse, tennis courts, etc., and also great grassy spaces, which, however, are at periods brown and unattractive owing to the long dry seasons. Sunset, as seen from the Maidan when one looks westward over the river, is the most beautiful aspect of Calcutta—the haze and fine dust hanging low over the city, with a clear sky above, give wonderful colour effects, and the crowded masts of the shipping silhouetted against these complete a picture really unique.

Corresponding to the political importance of the city, the Royal visit had here a distinctly political and Imperial aspect. There was, of course, the reception by the Viceroy, Lord Minto, and it is interesting to note that H.R.H. was received by Lord Minto as Governor-General of Canada when the *Ophir* made the journey round the world. The Tashi Lama—the spiritual and temporal head of Thibet—paid an official visit to Calcutta to meet the Prince, and this is regarded as significant of close and friendly relations between the two Governments. His visit was certainly interesting, for his retinue was mounted on small shaggy Thibetan ponies, and the priests had most strange costumes. He is regarded by the Buddhists as of the greatest sanctity; his progress was accompanied by horn blowing, and the more devoted of the Buddhists reverently kissed his pony's tail. With him was the Tongsa Penlop, one of the leading chiefs of Bhutan, the independent mountain State lying between Thibet and India.

It was intended that from Calcutta the Prince and Princess should make a trip to Darjeeling, the hill station in the Himalayas which is used as a sanatorium, and at which there are several schools for those

BURMA—ELEPHANT AT WORK IN TIMBER-YARD.

European children who cannot go to England as very many do. Besides the cool climate, Darjeeling has splendid views of the mountains, and a visit is usually very pleasant. The journey is made by a little railway, looking almost like a toy, specially designed for the

hill-climbing, as this station is about 7000 feet above the sea. It is from these lower slopes of the Himalayas that large quantities of tea are produced.

The trip, however, had to be abandoned owing to the exceptionally unfavourable weather, and in its place

BURMESE PAGODA AT RANGOON.

the Prince and Princess spent a few days in a quiet visit to the Viceroy at his country residence at Barrackpur. This is about ten miles north of Calcutta, and was used as a summer resort in days before the hill stations were thus utilised. The journey from Calcutta to Barrackpur is very interesting, for there are many curious features of Indian life to be observed. For example, there is the interesting if rather unpleasant sight of the Burning Ghat where the dead are cremated, and as one passes by there are usually several funeral pyres sending up their smoke and perhaps reminding one of that horrible practice of Suttee, now abolished, in which the widows met their death on the funeral pyre of their husbands.

There is a certain similarity between Calcutta and Rangoon, to which the Prince proceeded when he left India proper for a visit to Burma. Burma may be said to consist of three kinds of country: mountain ranges running north and south, long river valleys between them, and a low coastal plain. The valleys are drained by the three rivers, the Irawadi, the Sittong, and the Salwin, and the coastal plain is in part formed by the deltas of these rivers. In the delta at the mouths of the Irawadi and Sittong is Rangoon, and it is therefore similar to Calcutta in being built on a great mass of mud deposited at the mouth of two important rivers. Consequently there are several characteristics which they have in common. Each is swampy, hot, and unlovely, and each is a port for the fertile and populous valleys behind it.

Their history, too, is similar, for each is of recent growth, and is now a prosperous and still-growing commercial centre. Rangoon, however, is the younger; it was a mere village fifty years ago. It is also the smaller, for it has scarcely a third of the population of Calcutta, and indeed can never hope to rival that city, for it has not such a vast area for a "hinterland" as the capital of India possesses. Their trade is somewhat similar. Each is the outlet of a great rice-producing region, and from Rangoon the produce of the rice-fields (which sometimes give three crops in a year) is sent to India, for the needs of parts of that country are in this respect much greater than the local supplies. Then, too, the forests here give teak also, and cotton is now being cultivated with great hopes of success. From Upper Burma are sent the rubies for which the country has so long been famous; and a newer product is the oil which has now entered into serious competition with that of Russia and America.

Business enterprise seems the dominant note in Rangoon. Even the curious sight of elephants hauling and stacking teak in the timber yards and showing a docility and intelligence which are a constant source of interest to visitors, even this is disappearing before the advance of machinery. And just as this foreign importation is ousting the native elephants, so the traders and workers of many nationalities are ousting the Burman himself. About one-third of the population are Burmese, and as these take an obscure part in the life of the place, it seems to the visitor that the people are scarcely native at all. There are British and Indian soldiers, Indian police, Chinese traders, labourers from Madras and Bengal, Siamese, Cingalese, Annamese, and indeed people from all parts of Southern Asia.

Almost the only feature that is distinctly Burmese is the great Shwe Dagon Pagoda. This, or rather a small part of it, was erected as a shrine for some hairs of Buddha, and has been added to continually and without any definite plan, in order that those who took part in the work might "acquire merit." All round the central building are smaller ones, built with the same object. The central pagoda is as high as St. Paul's Cathedral, the smaller ones about twenty feet high, and all are gilded, for the provision of gold leaf for this purpose has been a favourite means of "acquiring merit." For this reason, too, there are hundreds of small altars, images, shrines, and bells surrounding the

RIVERSIDE VILLAGE IN BURMA.

structure, and the bells are rung by the devout Burman to draw attention to his meritorious deeds.

The difference in religion between the Hindus of India and the Buddhists of Burma is apparent in many ways. In the first place, there is no caste system among the Burmese, and the people are much more upon an

equality. There are yellow-robed monks, for example, but these are not drawn from one class, and every boy before entering manhood has to live for a time in a monastery and wear the yellow robe. The monks are vowed to poverty; they beg their food, and cannot own any possessions; they are the educationalists of the country, and the Burmese boys were taught reading and writing and the moral precepts of their religion long before education became universal in our own land.

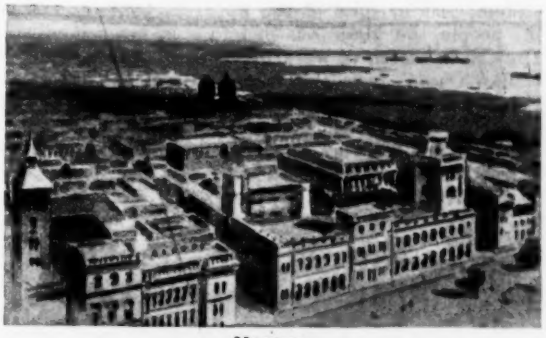
The Burmese doubtless owe their placid outlook upon life largely to their religion, which inculcates simple virtue aiming at an ultimate end of perfect peace, attained when the individual at last loses his individuality. This ideal, so greatly at variance with our Western admiration of energy and strenuousness, has been fostered by the very easy way in which Nature allows the people to live—their needs in that land are few and easily met. Further, these ideals and habits are now putting them at a great disadvantage when their land is being invaded by peoples of other ideals and more energetic habits.

A kindred feature of the Burmese character is their gaiety and general happiness of disposition. This expresses itself, for example, in their dress, which is very similar for men and women. Both have a coloured skirt and white jacket, and the women have this surmounted by a bright scarf. They all wear the hair long, but the men may do it up with a coloured handkerchief and the women with flowers. Generally speaking, the colours are pleasing, and the dress is distinctly more artistic than that prevailing in India. Altogether life seems brighter in Burma than in India, and the difference is most marked in the treatment of women. Instead of being secluded as so many of their Indian sisters are, the women of Burma take a full share—frequently more than a share—in the life of the country. A traveller passing from one country to the other cannot fail to notice the contrast, and there is no doubt that Burma owes much of its relative happiness to this cause.

The journey up the Irawadi reveals many of the peculiarities of the people, for the national life seems to centre on the great water-ways. The illustration shows the curiously-built houses, raised on piles well above the ground which is frequently inundated by the water coming down in mighty floods from the mountains. The houses consist essentially of a platform lashed to the bamboo or teak piles, with walls of matting. They are always of one storey, even the largest of them, for the people strongly object to any one being above their heads.

When the Prince went up-country he witnessed a series of boat, or rather canoe, races, for the Burmese are very fond of this sport and very skilful in the management of their canoes. The scene was as animated and brilliant as that at Henley, and therefore seemed quite characteristic of the people. The visit to Mandalay recalls the fact that Upper Burma has only been added to the Empire comparatively recently, for it is now just twenty years since the atrocious misgovernment and the wholesale slaughter by King Theebaw led to the entrance of the British and the acquisition of the country. There has been since then a great development of the resources of the land and the extension of railways hundreds of miles up the valleys, and one has to look forward to further great changes in the near future.

The *Renown* and the *Terrible* conveyed the Royal party from Calcutta to Rangoon, and later back to India, this time to Madras. It is quite possible that the popular idea of Madras is of a low coast with very shallow sea extending so far from the land that such large ships could not approach the landing-place, yet this is not so, for there have been great improvements, and the *Renown* and *Terrible* came quite close to the land. The improvements have been very costly, for there is certainly no natural harbour, and the native surf-boats and the small catamarans with their outriggers have impressed this idea firmly on the mind of Europeans. Somehow the rest of India—that is to say, of its European element—looks down on Madras, and the common conception is almost limited to surf



MADRAS.

breaking on a broad sandy beach with a rather sleepy town behind it.

The town certainly lacks some unpleasant features of places which are flourishing manufacturing and commercial centres, and it is being outstripped by more favourably placed cities, but it is far from insignificant, and has many good features.

Madras was one of the first possessions of the East India Company, and in the early days of British settlement was relatively a greater commercial centre than it is now. Clive went out as a clerk in the Company's service to Madras, and it was at Arcot, a little to the south-west, that he defeated the great army of the Nabob of Bengal, and laid the foundation of the British power. The rise of Madras was largely due to the English occupation, but the tide of progress has to some extent passed by and raised Calcutta and Bombay above it. Calcutta with its million people is the great port of North-Eastern India—it is the only possible great port of that part of the country. Bombay with its three-quarters of a million of people is the gateway of India from Europe. Madras with half a million of people is neither a well-marked outlet of a great natural region, nor is it a gateway to one of the world's highways. There are other ports near it which share the trade of the south of India, and the development of the railways across the northern part of the country has left Madras, as it were, in a backwater.

Yet, for all that, Madras seems cheerful. The city is very spacious. It covers nearly forty square miles, and has great parks and broad avenues. These give an appearance of coolness, quiet, and comfort, and the large European quarter is eminently leafy and suburban; in fact, the "white city" seems all suburbs.

The natives seemed quite happy when they crowded

in unprecedented numbers to witness the Prince's arrival. In this part of India they are of different race entirely from those of the North-West; here are the descendants of those earlier peoples who preceded the Aryans, and the languages here are quite of another type than those heard in the former part of the tour. Brahmanism is very strict; the Mohammedan influences do not seem to have weakened its hold upon the people, and consequently the caste system is remarkably strong, and the distinctions between the different castes are stringently observed. The Brahman is regarded with almost divine reverence; he does not mix with the other people, but remains apart as though he fears infection from the common throng.

Yet in spite of this strict adherence to ancient custom, and in spite of the apparent contentment of the people, the Madrassis emigrate in large numbers. They go in search of work to all the lands around the Indian Ocean, from the African Coast to the Malay Peninsula, but they are very glad to return to their homeland after a time. This willingness to go to foreign lands for work is an adventurous trait in their character scarcely to be expected.

COURSE OF LESSONS IN DOMESTIC SCIENCE.

BEVERAGES.

Step I. Preparation.—As water forms the basis and most important constituent of all beverages, the first lesson on this subject should be devoted to the consideration of the principal sources of supply from which our water is drawn, and the forms in which it is found in Nature.

Principal Sources. 1. *Rain-Water.*—Rain is the primary source of the whole of our water supply, but the term rain-water is restricted to that which is collected as it falls. Rain-water is soft, and contains no mineral matter in solution, but in passing through the air it carries with it soot and dust, and dissolves a certain amount of oxygen, which causes it more readily to dissolve lead from the gutters and pipes in which it is caught and stored. The Rivers Pollution Commissioners reported that rain-water "is rarely of sufficiently good quality to be used for domestic purposes with safety."

Springs, Wells, and Rivers.—After the rain percolates through the porous strata on which it falls, it will ultimately reach an impervious stratum, along which it will run in the direction of the downward slope until it reaches the outcrop of this stratum, when it will issue as a spring. Springs which issue from sand or gravel-beds are well filtered from impurities; those issuing from chalk give water that is, as a rule, free from impurities, but hard. Where there is no natural spring, the water may often be obtained by sinking a well through the porous soil, so that the water will drain into it; these may be (1) surface wells, which simply pass through the surface strata, and are therefore very liable to collect impure water which has been contaminated by cesspools, farmyards, etc.; (2) deep wells, which pass through an impervious stratum to a porous one beneath, and consequently collect water that has filtered through a considerable depth of soil, thereby losing those suspended impurities it may have acquired at the surface; (3) artesian wells, which tap the water that gathers in a basin-like depression between two impervious layers. River water generally contains mud, etc., in suspension, and therefore needs filtering. It is also liable to contamination by sewage, etc., which is, as a rule, discharged into rivers.

Distilled water is the purest form of water, but it is flat and insipid to taste. (Boil some water in a retort or a flask, and condense the steam until sufficient distilled water has been obtained for the scholars to taste.)

Kinds of Water.—As the water percolates through the earth it may pass through a bed of soluble material, in which case it will be charged with matter in solution when it issues as a spring. Many of these springs are celebrated for the medicinal properties of their waters, such as the springs at Bath and Tunbridge Wells, which contain iron, those at Harrogate, which have dissolved sulphuretted hydrogen, besides those of the various Continental spas, which give the well-known varieties of *natural mineral waters*, such as Hunyadi Janos, Vichy, etc. Water which contains carbonic acid gas in solution is able to dissolve chalk, which pure water cannot do. This may be illustrated by mixing chalk with water and passing a stream of carbonic acid gas through it, when the liquid will gradually become clear; if the clear liquid is boiled, the gas is driven off, and the chalk is again precipitated. Water in which chalk is dissolved is known as *hard* water. Although the hardness of water is not detrimental to it as a beverage, soft water is preferable for domestic purposes, as soap will not lather in hard water, but unites with the mineral matter to form an insoluble scum; when hard water is boiled the chalk is precipitated, causing the well-known "fur" on the insides of our kettles and boilers.

Step II. Presentation. 1. *The Necessity of Water in the Body.*—Water is as important to the maintenance of life as oxygen is—this is evident when we see that 70 per cent. of the body consists of water; it is necessary to maintain the fluidity of the blood, and for the removal of waste matter. Altogether, about 4½ pints of water are required daily, and as our solid food contains about 1½ pints, our beverages must contain about 3 pints. Water is the best beverage for a healthy person, but as there are many others in common use, we must consider their advantages and disadvantages.

2. *Nourishing Drinks.—Milk*, as we have seen in a former lesson, is almost a perfect food, and should therefore not be used as a beverage *in addition* to other food; the addition of soda water renders it more easily digested by neutralising any acids that may be present, and by rendering it less dense and heavy.

Cocoa is the seed of a plant found in Mexico and Central America, to which Linnæus gave the name *Cacao Theobroma*—literally, "food of the gods." The seeds, which are about the size of almonds, are placed on the market in three forms—(1) Cocoa-nibs, the seeds stripped of their husks and roughly broken; (2) Cocoa, the seed ground to powder and mixed with starch and sugar; (3) Chocolate, the fine powder mixed with sugar and flavoured with vanilla. The value of cocoa as a food will be seen from the following table:—

Proteids . . .	15·5 per cent.
Fats	50 „
Starch . . .	13·5 „
Theobromine . .	1·6 „

Theobromine has a stimulating effect upon the system, and it is to this active principle that cocoa owes its chief value as a beverage.

3. *Stimulating Non-Alcoholic Beverages.—Tea* is the leaf of an evergreen shrub grown in China, India, Ceylon, etc.; the leaves are gathered three times a year, the quality and flavour of the tea varying with the age of the leaf, the young leaf-buds being the most delicate. The stimulating effect of tea is due to the presence of *theine*, a substance very closely resembling theobromine in composition and effect. The leaf also contains *tannin*, as may be shown by adding a few drops of ferric chloride to a strong infusion of tea, which will immediately turn black; if the tea has only infused for a short time, the effect is not so marked.

Coffee is the seed of a berry grown in Arabia, Ceylon, and the West Indies. Each berry contains two seeds of a greenish-grey colour; these are first roasted and then ground to powder. The active principle contained in coffee is called *caffeine*, and is very similar to theine. Coffee is often adulterated with chicory, which is the root of the wild endive, but this can be easily detected by sprinkling a little of the coffee which is to be tested on a glass of water; pure coffee will float owing to the oil it contains, but chicory soon sinks, and gives a darker colour to the water than coffee does.

4. *Aerated and Acidulated Beverages.*—Taken in moderation, these are wholesome and refreshing, especially in hot weather.

5. *Alcoholic Drink.*—Alcohol is formed from grape sugar by fermentation, which breaks the sugar up into alcohol and carbonic acid gas. If the scholars are accustomed to chemical equations the change may be shown thus—

$$C_6H_{12}O_6 = 2C_2H_5OH + 2CO_2.$$

Place a solution of grape sugar in a flask the neck of which has been fitted with a bent glass tube, add a little yeast, and leave in a warm room for several hours with the bent tube leading into a gas jar. The liquid will soon commence to "work," as it is popularly called, that is to say, it will ferment, the sugar breaking up into CO_2, which will be collected by downward displacement in the gas jar, and alcohol, which remains in the liquid. The alcohol can be obtained by fractional distillation, that is, by raising the liquid to a temperature above the boiling point of alcohol (78° C.) and below that of water (100°); the vapour produced at such a temperature will be chiefly alcoholic, and the liquid obtained by distillation will be alcohol slightly diluted. This may be shown by placing a little of the liquid, that has been distilled over, on a watch-glass and igniting it. From this it is seen that the preparation of alcoholic liquid consists of two steps—(1) the preparation of the sugary liquid, and (2) the actual fermentation.

Beer.—The sugary liquid for the manufacture of beer should be prepared by steeping crushed malt in warm water (malt is barley which has just commenced to germinate); it then acquires a sweetish taste because the starch is converted into glucose. This is of course a natural process; but, as we saw in a former lesson, starch may be converted into glucose, or cane sugar into "invert sugar," by boiling with dilute sulphuric acid, hence instead of pure malt in the preparation of beer almost any substance that contains either sugar or starch finds its way into the mash-tub. Hops should be used to give the beer a bitter flavour and to make it keep, but a great deal of gentian, quassia, and other bitters now take the place of hops for flavouring purposes, while chemicals that are more or less injurious to the system are added to prevent secondary fermentation.

Wine is a fermented liquor similar to beer, but in this case the sugary liquid should be the juice of the grape; potatoes, rhubarb, etc., are often employed, however, in the preparation of wine, sugar and alum being added to flavour it and logwood to give it the required colour.

Spirits are obtained by distilling the spirit formed by some process of fermentation, and therefore contain a much larger percentage of alcohol.

Step III. Association.—Having considered the preparation and properties of these various beverages, we will now compare their relative values. The only beverages that possess any value as foods are milk and cocoa; the nutritive value of beer, even of the so-called "nourishing stout," is practically nothing, what little it has being due to the presence of sugar, and the result of beer-drinking is not the growth of muscle, but the unhealthy accumulation of fat. Tea, coffee, cocoa, and alcoholic liquors all act as stimulants; the effect of the non-alcoholic stimulants is to increase the strength and rapidity of the heart's action and to stimulate the kidneys, and if taken in moderation *there is no after depression resulting from the use of these stimulants*, although, if taken in excess, tea and coffee will give rise to nervousness. Most of the evils that result from tea-drinking are due to the crude methods employed in making the tea, whereby an undue amount of tannin is extracted, which retards digestion by coagulating the albumen; for this reason tea should never be taken immediately after dinner, as it is calculated to lead to indigestion. The effects of alcohol on the system are much greater than those of tea or coffee; the stomach is dilated, the action of the heart is quickened, respiration is affected, and, in fact, almost every organ of the body is influenced by it. The nerves are affected, the first result being an excited sensation which has led to the belief that alcohol enables a person to endure more fatigue than he could without; but experience has shown just the reverse, for soldiers on the march have been found to go farther with less fatigue without alcohol than they can with it, for the excited condition soon passes off and *a feeling of depression takes its place.* Another fallacy connected with the use of alcohol is, that it is able to warm the body; the fact is that alcohol dilates the blood-vessels of the skin, thus producing a sensation of warmth, but this surface heat is soon lost by radiation, and the body is left particularly susceptible to cold. These are the effects of what is generally known as a moderate use of alcohol; the long-continued immoderate use of it will affect the kidneys and the brain, causing gout, Bright's disease, and insanity.

Step IV. Formulation.—Water is the natural and best beverage; 3 pints per day are necessary.

Rain-water is pure, but is so easily contaminated that its use for drinking purposes is not recommended.

Spring-water is generally free from solid impurities, but often contains matter in solution—such as mineral salts, making natural mineral water, or chalk, making the water hard.

Water in surface wells is particularly liable to contamination.

Nourishing Drinks.—Milk and cocoa.

Stimulating Non-Alcoholic Drinks.—Tea and coffee owe their stimulating properties to theine and caffeine respectively. Tea also contains tannin, which retards digestion.

Alcoholic Liquors are prepared by fermentation, by which grape sugar is converted into alcohol and carbonic acid gas.

Step V. Application.—These lessons should enable the scholars to select the beverage most suited to the conditions attending its consumption. They should also lead the children to see that alcoholic liquors are inferior to others as beverages, and that they cannot be taken even in moderate quantities without injury to the system. Space forbids us to dilate on this point, but those who wish further information should get the pamphlet recently published by the British Medical Temperance Association.

NOTES ON AN EXPERIMENTAL COURSE OF LESSONS ON PLANT LIFE AND SOIL.

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(*Continued from p.* 470.)

Experiment 35.—An intermediate product of the reaction between cellulose and strong sulphuric acid may be obtained by dipping some paper for a moment into the concentrated acid contained in a dish, transferring it to a dish of water, and then pouring on to it a few drops of iodine solution. A blue colour is at once produced.

Some papers contain sufficient impurity to give a slight blue colour with iodine before treatment with sulphuric acid. If a satisfactorily pure paper is not at hand, Swedish filter paper should be obtained. This should show no charring in Experiment 34, and no blue colour with iodine until it has been acted upon by sulphuric acid.

Experiment 36.—A realistic method of showing the formation of a substance closely allied to starch is to dip half of a piece of filter paper or thin blotting paper into strong sulphuric acid; at once transfer to water and wash well, adding a little sodium carbonate to the wash water to remove all trace of free acid. Then iron the paper. The part that went into the acid is now stiff as a starched collar and resembles parchment, the other part, which was not acted upon by the acid, has undergone little or no change.

The substance formed in these last two experiments is not actually starch, but it resembles it so closely that the points of difference could not easily be stated. It is usually designated by the non-committal name "amyloid."

It is now desirable to demonstrate the composition of cellulose by the methods employed in Experiments 3, 4, and 10. In view of the intimate relationship between cellulose, sugar, and starch, it is not surprising to find that cellulose, like the other two, is made of carbon, hydrogen, and oxygen.

The plant seems to have no difficulty in converting these substances one into the other. The starch in the seed is changed, during germination, into sugar, part of which is converted into cellulose in the young plant. We shall see later on that the same process takes place in the plant throughout its life.

We have used the word cellulose as if it stood for one definite substance. This is hardly correct. The celluloses are associated with the cell walls of the plant; in the young plant they are easily decomposed. With age they become more complex and form woody and fibrous matter of various kinds. Good examples of pure cellulose are filter paper made from linen rags (the bast fibres of the flax stem) and cotton wool (cells attached to the seeds of the cotton plant). The different celluloses differ in their power of resisting acids, atmospheric influences, etc., consequently papers made respectively from wood pulp, straw, and linen rags, though all forms of cellulose, will differ greatly in durability.

Sugar and starch, on the other hand, occur in the cell contents, and not in the cell wall. Their function is to feed the plant and in part to be converted into cellulose at the growing points.

Jelly-Forming Substances.

Experiment 37.—Break up some linseed in a mortar, place in an evaporating basin, and stir well with ten times its bulk of boiling water. Heat, then allow to cool; notice that the material has absorbed water, swelled, and set to a jelly. Squeeze through linen to free it from the linseed husk.

Linseed cake, or the residue from Experiment 39, may be used instead of pure linseed.

Linseed jelly is of the same nature as apple jelly or orange jelly, and is a safer substance for the male experimenter to prepare. Jelly-forming substances are of wide occurrence in vegetables—*e.g.* potatoes, carrots, etc., and in fruits; like starch, they are readily convertible into sugar.

Experiment 38.—Boil a little of the jelly for some time with a few drops of dilute hydrochloric acid, neutralise the solution with caustic soda, and boil with Fehling's solution. A red precipitate is obtained.

The jelly-forming substances are technically known as mucilages and pectoses.

Cellulose, starch, pectose, mucilage, and sugar used to be called "carbohydrates," and the name is still useful as indicating their close relationship, and their sharp distinction from the oils.

Oils.

All plants contain oil, but in such small proportion that demonstration is a matter of some difficulty. Certain seeds, however, contain large quantities.

Experiment 39.—Grind some linseed, shake it in a bottle for some minutes with about twice its bulk of ordinary ether or petroleum ether. Pour off through a filter, allow the yellowish liquid to evaporate in the open air, and observe the oil left behind.

Be very careful that no lights are anywhere near the evaporating ether. Owing to its dangerous properties ether should not be stored, but purchased in small quantities as required.

Oil contains carbon, hydrogen, and oxygen only, but it does not belong to the group of sugar-forming substances we have so far been dealing with. Treatment with dilute acids, as in Experiment 38, yields glycerine and a "fatty acid." If caustic soda is substituted for sulphuric acid, glycerine and a soap are produced; caustic potash yields a soft soap.

Protein.

Experiment 40.—In order to demonstrate the presence of protein in the plant, begin by cutting the plant up into small pieces and drying in a baking tin placed on a stove. The drying should at first be rapid in order to kill the cells and any micro-organisms which may be present; the temperature should not, however, be high enough to burn the plant. Then heat the powdered dry matter in a test tube, as in Experiment 9 (p. 355), either alone or, better, with soda lime, and hold a test paper in the escaping gases. Ammonia is evolved.

Drying the plant greatly facilitates the experiment; with an undried plant the apparatus is liable to break owing to the large amount of water produced, and in any case the great volume of steam dilutes the ammonia to so great an extent that no satisfactory result is obtained.

Acids.

Experiment 41.—Wash some freshly gathered roots to remove soil, then bruise and test the sap with blue test paper. It will be found to be acid. Leaves and stalks give a similar result.

At one time it was thought that the plant obtained some of its food by means of the acid root sap. This was supposed to pass out from the root, and dissolve certain soil materials, which then entered the plant. The hypothesis is now, however, generally discredited.

Poisons.

Certain plants contain poisonous substances, and the country teacher may be able to cite local instances of cattle being killed by eating injurious plants. Yew, poppy, deadly nightshade, henbane, hemlock, and greater celandine may be mentioned; these contain poisons known as alkaloids. The sting of the nettle is a poison of rather a different nature, known as a toxin; the pollen of certain grasses has injurious effects, producing hay fever. In this case the toxin and its appropriate anti-toxin have been described.

Essential Oils, Essences.

Experiment 42.—Place some pieces of orange peel in a flask with water. Distil off one-third of the water; notice that the distillate is slightly turbid and contains the material giving the scent.

Heads of lavender, tea, and red clover may be used.

Experiment 43.—The essential oil may also be extracted by means of lard. Grind up some rosemary or lavender, put into lard, and leave for a time. The scented substance dissolves in the lard.

These two methods are actually adopted for making such natural essential oils as are used in perfumery and for other purposes.

The list of plant constituents is by no means exhausted. Certain plants have considerable real or reputed medicinal value; *e.g.* coltsfoot, elder, greater celandine, self-heal, sanicle, tansy, the potentils, vervain. Others were highly valued in days gone by for household purposes; land cress, salad-burnet, laurel were used as components of salads; borage, mugwort, and others were added to drinks; woodruff was put into the linen press, and so on. The characteristic properties in all cases depend on the presence of some substance or substances, often in small quantities, which may either be unclassed or go into the last two somewhat indefinite groups given above.

COMMON-SENSE NEEDLEWORK.

BY MISS FLEMING,

Authoress of "How to Teach Needlework," "Pupil-Teachers' Needlework," "Sewing-Class Guides," etc.

"THE teaching of needlework should be arranged so as to have educational value as a form of manual training, as well as immediate practical utility. The course of instruction should, therefore, be progressive in character, and each girl should as soon as possible in the course make a useful garment.

. . . . . .

"New stitches should always be taught on waste material, but when thoroughly mastered should at once be applied to the making or mending of garments. It is important that sufficient opportunity should be given for practice in mending garments; but in cases where there are sanitary or other difficulties, pieces of material may be used to represent the various parts of garments needing special kinds of repairs."

These extracts from the "Suggestions for the Consideration of Teachers," issued by the Board of Education, indicate the lines on which it is expected that needlework will be taught in the future. Certainly the importance of the subject in its relation to home life calls for more practical methods than have hitherto been adopted.

What has been the result of the teaching of needlework in Elementary Schools since the passing of the Education Act of 1870? Has it made more thrifty, painstaking needlewomen of the working classes? The answer is humiliating.

Time was when almost every prospective bride made her own trousseau, proudly putting her best stitchery into all her under garments and household linen.

Now all "lingerie" must be bought ready-made, and even sheets and tablecloths are machine stitched before they leave the shop. The buying of shop-made goods has spread through all classes of society, reaching even to the lowest strata, where very many of the poorest buy wearing apparel as cheaply as possible and wear it till it drops into rags, without ever putting a stitch into it.

A very cursory glance at the pinafores worn by school children—many of which are destitute of either strings or buttons all the while they are worn—will prove the truth of the statement.

Surely we elementary teachers, through whose hands most of the working women must pass, have some responsibility in this matter of decline of inclination or ability to sew.

Sewing-machines have taken away much of the necessity for hand-made work, while the hurry and bustle of modern life have led women to imagine they have "no time" for needlework. But surely this homely, womanly, soothing occupation is too precious to be allowed to pass into desuetude without a strenuous effort being made on its behalf.

The many exercises and specimens worked in school on nice little squares of *new* calico or flannel have no apparent relationship to the wear and tear of personal garments, and children, who are essentially utilitarians, take no pleasure in doing what seem to them unnecessary labour.

As soon as they realise that they can replace a hole in their pinafore by a neat patch, they begin to take a delight in the subject.

Then, too, the fine eye-straining stitchery done in some schools is so eminently unsuited to practical everyday needs, that little or no attempt has been made to apply it after school is left.

Even teachers never think of mending their personal linen by means of the microscopic stitches used in many schools, P.T. Centres, and Training Colleges.

Mothers of families have no time for such fine stitchery, and garments, worn and torn by romping school children, do not admit of the correctly shaped tiny patch worked in school. Always using new materials in class, girls have not learned to appreciate the beauty, as well as the usefulness, of a sensibly patched garment.

Thus it comes about, that although sewing has been for thirty years compulsory in all girls' schools, yet the pupils have not learnt to like doing it.

One reason for this is, that we teachers have begun at the wrong end. We have attempted to make little children produce tiny stitches before their muscles and joints were supple enough to perform such delicate operations.

All instructors of writing have realised that in the initial stages of the art the beginning must be clear and bold, and so "large hand" is prescribed for tiny tots, and the writing becomes gradually smaller as progress is made.

At the same time, little children of seven, and even less, have been expected to put so many stitches into the inch, and in some cases, even to work by a thread, no notice being taken of the manner in which the work is held, the needle manipulated, or the regularity *or continuing* of the movement.

The "Suggestions" just issued by the Education Department wisely do not insist on infants being taught to sew at all until they are six years old.

Watch a skilled needlewoman at work and notice how her needle slips in and out with grace and freedom of movement, and then notice how laboriously the girls in the top class in most schools push in and draw out their needles! They have not learned to sew at all—only to prick holes in calico with more or less exertion. No wonder they say when they leave school they "do not like sewing"! The *methods of teaching have been at fault*, and we must reconstruct them if we wish for real success.

The aim and scope of these papers differ from ordinary needlework manuals, in that their purpose is to accentuate two somewhat overlooked yet vital points—*i.e.* (1) *The necessity for "continued motion"* in sewing, and (2) the *application* of the school exercises to home work; in other words, the art of mending or repairing.

Perfection of detail can only be expected after years of practice, but our girls ought at least, before they leave school, to be able to sew and *go on sewing*—not simply to toil at making a stitch.

It is this *continuing the motion* or "rhythm of sewing" that I am pleading for, and upon which I base part of my claim to "Common-sense" work.

Until a child can do a piece of hemming or seaming, and *keep up the movement* for some minutes, she cannot sew, and it is no use teaching buttonholing or any of the more advanced needlework, until this elementary process can be performed easily and continuously.

On the other hand, a girl who can keep up this movement having only learnt to seam and hem with facility, will be in a far better position for learning the higher branches of the work, and, what is far more important, she will gain a liking for the work.

We all have pleasure in doing what we feel we *can* do, and when girls have acquired the power to sew easily and gracefully they like doing it.

This "keeping up the movement" necessarily means that quicker manipulation is secured and longer strips must be provided for practice, so that more calico and other materials will be required, as the method will produce quick sewers.

Another characteristic of the "Common-sense" method is the fact, that as soon as any exercise has been learnt in class on new material, it must be practised on garments brought from home, so that the girls may realise that the first is only a means by which the second may be accomplished, for the mechanical process has no value if it be not applied to something practical.

That is precisely the spirit of the "Suggestions," which distinctly states that as soon as an exercise has been learnt on raw material, it must be applied to wearing apparel.

In order to see that the class is working by proper methods, the teacher's place is in front of her class that she may *see* that the needles are kept constantly in motion, and that thimbles and work are in their proper positions.

The three chief characteristics of the "Common-sense" method are—

(1) Insistence on continuity of motion.
(2) For this purpose and to see that all implements are properly used, the teacher must manage her class entirely from the front.
(3) The application of all mending exercises to wearing apparel and household linen as soon as the method of working has been taught.

The aim of the following papers will be to secure these results.

A Plea for Needlework—especially for the *Repairing of Garments.*

"If the domestic duties be well performed there will be no need to go afar to offer sacrifice."—Confucius.

Most people will admit that the repairing of garments is an art that has been too much neglected during the last half century, and that it is absolutely necessary that girls should be instructed in that art if the "cottage homes of England" are to continue to be nurseries where thrift and economy are inculcated.

The art of mending torn and worn garments is, at least, as valuable for girls in Elementary Schools as that of making new ones. It would not be too much to go a step further and say that it is even more valuable, because there never was a time when so many shop-made garments were used, and as people *will* buy them, it becomes more imperative to know how to prolong the life of an article than how to make a new one.

If a girl be taught to keep her garments in a sound condition and herself neat and tidy, she will instinctively rebel against rags and disorder in her home and surroundings. A girl, when writing to her teacher, said, "Since I have learned to mend I can't bear to see a hole." The mother of another girl who attended the same school said, "I cannot get Mary to put on a frock with the elbows out."

Thus an instinctive objection to untidiness and

disorder soon grows, and it is but natural to expect that home will be rendered more attractive and comfortable in consequence.

Men will less rarely be found in the public-house when their homes become places of comfort and order.

I claim for needlework a wonderful soothing power. It has some of the effects on a woman that a pipe of tobacco has on a man, with this important addition, that it is a means of saving money instead of spending it. The very monotony of sewing, the rhythm of the needle as it swiftly glides in and out, forms, in itself, a valuable nerve-soothing occupation, which ought to be more highly appreciated than it is in these days of hurry, bustle, and confusion. The nerves are quieted, and many of the creases and worries of life are smoothed out while stitches are being put into little garments that have been worn on restless little limbs. When a mother is fretted and jaded by anxieties innumerable, when nerves are tingling to the finger-tips, when she is so irritable that everything seems to go wrong, if she could but sit down quietly to do a little sewing she would realise that the rhythmic movements of the needle would calm and soothe her irritability. In perhaps no department of life is the axiom "Prevention is better than cure" truer than in needlework. How many men's tempers are sorely tried because of the missing button when the collar is put on!

Girls at a very early age can be taught to sew on buttons, and they are proud to be allowed to undertake the weekly duty of securing such fasteners as are loose and adding new ones, if only a little encouragement be given them.

On mending days in the very lowest class in one school, girls may be seen with bundles of pinafores, skirts, etc., to be put right by the nimble little fingers. They are delighted to recount also what they do at home. They are happier when usefully employed than even when playing, and they like to know that they are "helping mother." They early realise the valuable lesson, that the greatest happiness lies in being of use to those whom we love. After having thus been taught how to perform certain tasks correctly, they should be held responsible for the regular performance of these duties.

Many girls in the school referred to darn all the stockings for the family, and very proud they are of the task. One girl took particular delight in herring-boning. A sheet-mending lesson had been given to her class, and the teacher told them incidentally that blankets could be mended in a similar fashion by substituting herring-bone for hemming and seaming. This fired the girl with a desire to repair all the blankets. Accordingly next mending day she brought a big bundle, which proved to be a blanket. She arranged the patches on the mending table and proceeded with the sewing. As the lesson was not long enough to allow her to complete her task, she finished it at home. Being early summer all the blankets had been washed, so they were overhauled by her, and then she took upon herself the same task with regard to the sheets.

Another girl found special pleasure in patching, and she easily persuaded her mother to let her try her hand on all garments to be patched.

It is the *desire to do* that is of the utmost importance, and when once girls get into the "rhythm" of sewing, which may be styled the poetry of motion, the mere putting the needle backwards and forwards becomes a pleasure and not a labour. When the general principles of repairing have been learnt, there is still enough mental effort required to find the best method adapted to each particular case, to prevent the exercise becoming mechanical.

Needlework has still another advantage for housewives, it gives opportunity for planning the next day's work, and well arranged work is already half done.

It is conducive to economy too, for while fingers are busy with garments which older children have almost outgrown, a clever woman will be devising ways and means of utilising them for the younger children, or she will concoct some plan for furbishing and altering, whereby garments may be made to do duty another season.

There is a pleasure that comes from adapting an already well-worn article to some new use that is somewhat akin to the joy the artist knows when he conceives a new idea for his picture, or an author a new plot for his book.

OUR ILLUSTRATED GEOGRAPHICAL NOTE-BOOK.

NATAL.

The Colony of the Immigrant Hindoo.

THOUGH it was on Christmas Day 1497 that Vasco de Gama first sighted Natal, nearly two centuries elapsed before any Britons set foot upon its soil. In 1683 a British ship was wrecked off the north-east coast, and the eighty survivors journeyed overland to the Cape, where the Dutch were established. The year 1824 saw the first attempt at European settlement in Natal, when two ex-officers of the British navy, with other adventurers, obtained a grant of land from the Zulu king, Chaka, who was then in possession of the territory; this concession extended from the coast to 100 miles inland. The assassination of Chaka was the forerunner of disaster to the whites, for his brother Dingaan, who succeeded him, killed some of the Europeans, and the others had to withdraw to beyond his borders.

In 1835 a few Boers from Cape Colony and a party of American missionaries founded a colony to which in 1837 they gave the name Victoria. In the meantime matters in Cape Colony were proceeding by no means smoothly. The Boers had never taken kindly to British domination, and when at last their slaves were freed with insufficient compensation, their patience was strained to breaking-point. Large numbers of them trekked to the north-east to a territory that swarmed with game, and that had water and pasture for their flocks and herds.

In 1837 Pieter Retief, who had played a prominent part in establishing what was afterwards the Orange Free State, crossed the Drakensburg Mountains to prospect the pleasant fertile land that sloped in terraces down to the Indian Ocean. Dingaan received the Boer prospectors with every appearance of hospitality, and in consideration of Retief recovering a herd of cattle that had been stolen from the Zulus, made him a grant of practically all the territory now forming Natal proper. The Boer leader closed with the bargain, and

after securing the cattle, set out with his friends for Natal. The new settlers possessed no less than a thousand waggons. Arrived at Dingaan's capital, the whole party was treacherously massacred, and a few hours later 10,000 Zulus were marching on the nearest Boer encampment. Where Weenen now stands 300 Boer women and children and a large number of Hottentot servants were remorselessly slaughtered. Fortunately one young man escaped to warn the whites of the approach of Dingaan's forces. In several fiercely contested encounters which followed, the advantage lay with the Zulus.

When Andries Pretorius succeeded to the Boer command, he gathered a force of 500 whites with which to attack the Zulus. Dingaan immediately gave them battle, but lost 3000 men in a two hours' engagement, and after setting fire to his capital of concentric circles of huts, he fled into regions where it was inadvisable to pursue him. A year later Dingaan was assassinated at the instigation of his younger brother, Panda, with whom Pretorius had allied himself. Natal at last knew peace, and became a republic, with the young Zulu king as a loyal vassal.

The Boers now held a large tract of territory north of the Orange River, together with Natal. The British, however, did not view with approval the proximity of independent States whose rulers dealt with the natives in a manner repugnant to British minds, and especially did they object to allow the Boers to dominate any portion of the seaboard. Sir George Napier, the Governor of the Cape, sent a small force to Durban. Pretorius at first repulsed them, but reinforcements arriving, Natal passed into the possession of the British in July 1842. The immediate consequence was that the recalcitrant Boers again trekked northwards. For a time there was a total collapse of anything like settled rule, large numbers of Bantus swarmed into the land, and Panda again secured his independence. In May 1843 the territory was formally attached to Cape Colony, and it was only in November 1856 that Natal was erected into a separate colony.

By 1852 there were 8000 settlers of European descent, of whom less than one half were of Dutch extraction, and there commenced for Natal a period of steady progress that remained undisturbed until 1873. In that year Langa, a Kaffir chief, was summoned to Pietermaritzburg to be examined concerning the purchase of firearms by some of his young men, the possession of guns only being allowed to natives who registered their names with the magistrate of the district. The Kaffirs in question had failed to comply with this regulation, and the chief supported them by refusing to appear before the Governor of Natal. Langa fled to Basutoland, but was eventually captured and imprisoned for life on Robben Island, near Cape Town. Owing to the denunciations of Bishop Colenso and the Aborigines Protection Society, the Governor of Natal was recalled, Langa was removed to a farm on the mainland, compensation was paid to his tribe, and a special commissioner, Sir Garnet Wolseley, was sent out from England to inquire into the relations of the colony with its native subjects. The result was that the natives in the reserves became subject to the ordinary criminal law, while civil cases were to be tried by a native high court. Since that time until quite recently the Natal Kaffirs have been exceedingly loyal subjects, and have made great strides in civilisation.

But for years the Zulus in the neighbouring territory were a standing menace to the peace of Natal. In 1878 war broke out between Great Britain and the Zulu chief, Cetewayo. Memorable features of the campaign were a British disaster at Isandhlwana, the heroic defence of Rorke's Drift, and an overwhelming defeat of the Zulus at Ulundi. The next year there was war between Britain and the Boers, a struggle marked by four British defeats, the last of which was at Majuba Hill, in the extreme north of Natal. During the last South African war the Boers invaded Natal, and many important engagements took place along the line of railway. The heroic defence of Ladysmith, and the operations that led to its relief, will ever be remembered in the annals of the British army. There is now every prospect that there is dawning on Natal, the "Garden Colony," the most British of our South African possessions, an era of prosperity such as she

has never known. At the conclusion of the war she received an accession of territory in the addition of Utrecht and Vryheid (see shaded portion of sketch map), and Zululand is now an integral part of the colony.

Physical Features.—The configuration of Natal will be readily understood by reference to our contour map of the main line of railway. From the sea towards the Drakenberg Mountains a series of almost regular terraces attain an altitude of 2¼ miles. For the first 15 miles inland the land rises to a height of 1000 feet, and during the next 20 miles 2500 feet is attained. The third terrace, about 25 miles in width, ends in an elevation of 3700 feet; the fourth terrace brings us to the neighbourhood of Weston and Estcourt, at a height of nearly 5000 feet; while towards the western border the altitude increases to 6000 feet. In the Drakenberg, "haze-wrapt and distant, crowned by fleecy clouds," snow-clad peaks are no uncommon sight. The build of the country does not lend itself to the existence of navigable rivers; of the thirty-five rivers that enter the Indian Ocean, only one or two have a few navigable miles at their mouth; and thus the easiest means of transport is denied to the colony.

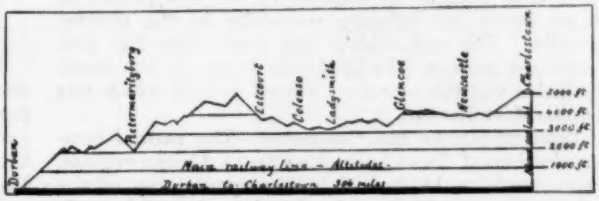
Being nearer to the tropics, the temperature exceeds that of the Cape. There are practically only two seasons, summer and winter, for spring and autumn are so brief as to be scarcely recognisable. The wet or summer season lasts from October to March, and the dry or winter season from April to September. The low coast-lands experience the greatest heat. At Durban the highest temperature in the shade reaches 100°, and for a considerable part of the year it exceeds 90°, and seldom does it descend below 50°. At Pietermaritzburg the average temperature is about 65°, sometimes going down as low as 33°. The varying elevations naturally cause marked differences in climate even between comparatively neighbouring districts. On the whole, the climate of Natal may be regarded as semi-tropical, but the summer heat is modified by copious rains. Snow is rarely experienced, but hail-storms occasionally do enormous damage.

Productions and Industries.—The vegetable productions correspond to the climate of the various levels in the land. The heat of the coast districts is favourable to the cultivation of sugar, tea, coffee, cotton, tobacco, arrowroot, and tropical fruits; the midlands, cold in winter, are most suitable for agriculture and stock; and the uplands are the chief grazing-grounds for sheep, cattle, and horses.

SUGAR.—Sugar-canes were first introduced from Bourbon in 1848. The first plantations were at Durban and at Compensation, on the road to Stanger. The experiment was a success, and four years later 15,000 additional plants were obtained from Mauritius. The year 1856 saw the first exports of 2 cwts. of sugar, and the industry grew steadily, until in 1876 there were sixty-six sugar-mills at work. The annual output now exceeds 30,000 tons.

TEA.—Coffee-planting was for a time successful, until the sudden failure of the crops, as they had failed in Ceylon, caused planters to turn their attention to tea. In 1877, 4000 seedlings were obtained from Assam, but owing to drought only about a quarter of them succeeded. Continued drought and insect pests for several years caused discouragement, but eventually the industry became firmly established. The plant thrives best at an elevation of about 1000 feet, beyond that the necessary humidity is usually lacking. In the colony there are now about 4000 acres under tea, yielding on an average 600 lbs. per acre, and where the conditions are exceptionally favourable, twice that amount. Natal tea is said to be more wholesome than the Indian variety, being richer in caffein, while containing a lower percentage of tannic acid. Natal produces about 2,000,000 lbs. of tea per annum, which is insufficient for her own needs by some 145,000 lbs. The Cape and the ex-Boer Republics require quite four million lbs., and there is no reason why Natal should not provide every ounce of it, for there is plenty of suitable land awaiting the planter.

TOBACCO, in small patches, is grown everywhere in the colony, but *cotton* has yet made little progress, although in the special interests of Lancashire spinners the Government is encouraging cotton cultivation in Zululand by the offer of land at specially low rents.



CEREALS.—The chief grain crop is *maize*, or mealies, which forms the staple food of the natives, who also grow large quantities of Kaffir corn. *Wheat*, chiefly in the uplands, is a small crop; Utrecht has the largest area. *Oats* and *barley* are general throughout the midlands and uplands. *Potatoes* and most common English vegetables succeed nearly everywhere, not infrequently yielding two crops in a season.

FRUIT.—It is a complete paradox that the "Garden Colony" imports practically all the preserved fruit and much of the fresh that the settlers require; this in face of the fact that all the fruits of sub-tropical character, as well as those hardy ones of the north temperate zone, only require scientific cultivation to ensure commercial success. The coast regions produce the *orange*, *lemon*, *lime*, *mango*, *coconut*, *banana*, *pine-apple*, etc.; a little farther inland the *vine* and *fig* will flourish; while in the uplands and midlands the *apple*, *pear*, *plum*, *peach*, *olive*, *apricot*, *mulberry*, etc., can be successfully grown. The demand for good fruit in the markets of Cape Colony and the Transvaal is now causing the colonists of Natal to bestir themselves in the matter of fruit culture.

STOCK-FARMING.—*Cattle* and *horses* are raised chiefly in the midland and northern divisions. Rinderpest occasionally causes great losses. Away from the railways cattle are used largely for transport, and are more valuable in this direction than for beef or milk. *Sheep-farming* is the chief industry of the colony. There are about 80,000 *Angora goats*, chiefly in the Klip River district, but the natives own probably ten times that number of common or Kaffir goats. *Dairy-farming* presents a remunerative opening for capital, for there is produced insufficient butter and cheese even for home consumption. Fresh butter is 2s. per lb.; imported cheese is 1s. 3d. per lb.; and eggs are 2s. to 3s. per dozen.

OSTRICH-FARMING is often quoted as an important

industry, whereas it has greatly declined, and it is doubtful if there are a thousand ostriches in the whole colony.

FORESTRY.—The Natal forests are chiefly in the kloofs of the mountain ranges, but they are no longer extensive. The chief woods are yellow-wood, sneezewood, and ironwood; the first named is harder than pine, and is largely used for domestic purposes. An important feature of forestry in Natal is the *Black Wattle* industry. Introduced from Australia twenty-five years ago, there are now 30,000 acres of plantations which yield firewood, pit-props, and large quantities of bark for tanning purposes. Wattle-planting is one of the few branches of forestry that commence bringing in profitable returns within the space of a few years.

MINERALS.—The colony possesses abundant supplies of *iron* ore, in places so rich that the natives with the crudest appliances easily obtain metal for spear-heads. *Gold* is of little or no importance, but *coal* gives rise to an important industry, especially in the Dundee district. The coal seldom lies more than 200 feet below the surface. In 1904 the output of the Natal coalfields was 858,000 tons, almost half of which was bunkered at Durban.

Communications and Commerce.—The natural communications of Natal, as in other South African regions, leave much to be desired. The opening up of the colony depends chiefly upon the extension of its railways, the scope for which is well shown in our sketch map. In the year 1860 was opened the two-mile line from the Point to Durban, and thus the colony was the pioneer of railways in the continent of Africa. The lines now open exceed 800 miles in length. Until 1892 the Natal railway carried the greater part of the Transvaal trade, goods being transferred at the border terminus to or from the cumbersome ox-waggons. In that year the Cape railway was extended to Johannesburg, and promptly the Natal railway traffic fell 20 per cent. Three years later Durban was placed in direct rail communication with the Transvaal, and in the year 1896 all previous receipts were doubled. Extensions are projected, or actually under construction, to open up additional good mineral, agricultural, and industrial districts, but the most important schemes afoot are additional and more direct routes to the Transvaal and the Cape, the latter *via* Richmond and Clydesdale.

Our small contour sketch of the main line will give some idea of the engineering difficulties that railway construction and working have had to compass in Natal. Long non-stop runs at a mile a minute, to which we are accustomed in the Mother Country, are quite out of the question. It is calculated that between the coast and Charlestown freights have to ascend nearly 2½ miles of a vertical elevation, for some of the more considerable altitudes are gained only to be lost again before another ascent presents itself. On the branch line to Harrismith there is a continuous rise to Van Reenen of 36 miles without a fall, until the highest railway elevation in Natal is attained—5520 feet.

IMPORTS AND EXPORTS.—In 1904 the total trade by land and sea was—

Imports	£10,991,000
Exports	9,010,000

The chief exports in point of value were coal, wool, maize, bark, sugar, hides and skins, and angora hair; but Natal produces scarcely a quarter of the total exports. The chief imports are metals, machinery, apparel, leather, cottons, carriages, furniture, and provisions.

People.—The population of Natal presents at least one feature unusual in British colonies. Compared with the natives the white settlers are in a great minority, as one might reasonably expect, but they are also outnumbered by Asiatics, Hindoo coolies who have had to be imported to provide the labour necessary for the sugar and tea plantations in particular.

Population, April 1904.

Europeans	97,109
Mixed and others	6,686
Asiatics	100,918
Natives (in service)	79,978
,, (in native areas)	824,063
	1,108,754

Even if the pay were attractive, white men cannot work out of doors in the hot climate of the coast regions. The native Kaffir takes life easily; he pays his hut tax of 14s. per annum, and for the rest is usually content to live in his kraal on the produce of his cattle, garden, and fowls. Stalwart in stature, and usually loyal in nature, he is not industrious, and cannot be relied upon for continuous service under one master. Faced with this difficulty, the white planters as early as 1860 found it necessary to import coolies to work on the sugar plantations. The system has been continued ever since, and even now Hindoos enter the colony at the rate of several thousands per annum, which is by no means equal to the demand.

The Hindoo population is under the especial care of an official called the "Protector of Indian Emigrants." They are brought to South Africa under engagements for five years' service with the option of returning home at the end of that period, or settling in the colony if they desire. Large numbers elect to remain in a land where the struggle for existence is less keen than at home. Very often when the coolie's indentured service ends he sets up for himself as a peddling fruit-seller, or if he has the means he adopts market-gardening, employing Kaffirs for the heavier work. Many former indentured coolies are largely occupied in the higher branches of trade and commerce.

Although it is a matter of regret that Kaffir labour is not a more reliable quantity, the objections that are urged against Chinese labour in the Transvaal do not equally apply to the Hindoos in Natal. As desirable colonists there is no comparison between the Chinaman and Hindoo, and in any case the latter even at home is under the British flag. In the Transvaal the question resolves itself into an economic one, whether the mine-owners can afford to employ white labour; in the coast regions of Natal the climatic conditions put the white man out of the question.

The Zulus are one of the finest races on the African continent. They generally recognise the necessity of discipline, and under European tuition they make good soldiers and policemen. Only a few weeks ago the Kaffirs on the borders of Zululand were somewhat rebellious, owing to the machinations of sedition-mongers. If the movement had assumed serious proportions it is certain that the loyal Zulus would have been called upon to assist in quelling the disturbance.

TABULATED HINTS FOR SCHOOL GARDENS.

Compiled by G. A. Taylor, F.R.H.S.

Crop.	Varieties to Grow.	When to Start Growing.	Quantity Required.	Cost.	Depth to Plant.	Distance apart for Crop.	Preparation of Soil for Crop.	Time of Germination.	Crop Ready.
Broad Beans	Green Windsor, Long pod	November for earlies. From January to end of March for main crop	1 pint to 40 ft.	3d. to 9d. pint Newest sorts fetch highest prices	3"	9" apart crosswise, viz. . . . . rows 3 ft. apart	Drills should be made a week before sowing in thoroughly good, well worked soil. A dusting of superphosphate at the rate of a handful to 1 yard run will be found beneficial	7 to 9 days	13 or 14 weeks
Dwarf or French Beans	Canadian Wonder, Ne plus ultra, King Edward VII. (climbing)	April, May, June	¾ pint to 40 ft.	6d. to 1s. per pint	3"	6" apart in rows 2 ft. apart	Drills should be prepared as above, but in a warm part of the garden	7 to 9 days	11 or 12 weeks
Runner or Scarlet Runner Beans	Al., Best of all, Ne plus ultra, Scarlet Emperor.	May, June, July	½ pint to 40 ft.	4d. to 1s. per pint	3"	1 ft. apart in rows 6 ft. apart	Furrows 9" deep should be made in enriched, deeply worked soil. The seeds should be covered with 3" of good soil. The shallow trench serves to retain the water of which this crop is fond	7 days	12 weeks
Peas	Sherwood, Daisy, and Chelsea Gem (earlies); Record, Peerless, and Gradus (main crop); Gladstone (lates)	November to January March to May To July	¾ pint to 40 ft.	4d. to 1s. per pint	2"	Thinned out to 2" apart. Rows 2 ft., 4 ft., or 6 ft. apart according to height	The ground should be enriched and well trenched. The crop should be earthed up after reaching some inches of growth. In a dry season a mulching of decayed manure lengthens the life of the yield	7 or 8 days	14 to 15 weeks
Beet	Dell's Crimson, Market Favorite, Best of all (long); Egyptian and Sutton's Globe (turnip rooted)	April May	1 oz. to 40 ft.	4d. to 8d. per oz.	1½"	In rows 15" apart thinned out to 9" apart	For this and the three succeeding crops no manure should be put into the ground for a long time previous to the sowing	8 to 10 days	18 to 20 weeks for long sorts, 12 to 14 weeks for turnip rooted
Carrots	Veitch's Matchless, Scarlet Perfection, Telegraph	March April	½ oz. to 40 ft.	4d. to 1s. per oz.	1"	In rows 15" apart. First thinning 3" apart, then use intermediate one. Final crop should be 9" apart	Do. Do. (A dusting of bone meal in furrow at time of sowing improves the colour of carrots)	12 to 15 days	18 to 24 weeks
Turnips	Early Milan, Snowball, Orange Jelly	From February to August for succession	½ oz. to 40 ft.	3d. or 4d. per oz.	1"	In rows 15" apart thinned out to 9" apart	Do Do.	5 to 7 days	8 to 9 weeks
Parsnips	Hollow Crown, Student	February March	½ oz. to 40 ft.	4d. to 6d. per oz.	1"	Do.	Do. Do.	12 to 18 days	18 to 20 weeks, but should be left in ground and used as a winter crop
Onions	Al., Ailsa Craig, Ne plus ultra, Brown Globe, White Spanish	Sow in heat in January, prick out seedlings, gradually harden off and plant out in April. Sow in open in April, or in August for next year's crop	½ oz. to 40 ft.	6d. to 1s. 6d. per oz.	1"	In rows 1 ft. apart. Thin out to 6" or 9" apart according as the sowing has been made soon or late in the season	The soil should be trenched deeply, say 2 ft. 6 in., and well treated. Ashes of garden refuse should be used with decayed cow manure. The ground should be very firm. After being established no feeding or watering is necessary. The same ground once thoroughly prepared will grow splendid onions for years	8 to 10 days	16 to 18 weeks

Tabulated Hints for School Gardens—*Continued.*

Crop.	Varieties to Grow.	When to Start Growing.	Quantity Required.	Cost.	Depth to Plant.	Distance apart for Crop.	Preparation of Soil for Crop.	Time of Germination.	Crop Ready.
Leeks and Celery	Musselburgh (leeks). Exhibition Red and Exhibition White (celery)	Sow in heat in February, prick out, harden off, and plant in open in April or May	½ oz. to 40 ft.	6d. to 1s. 6d. per oz.	1"	Plant out in trenches 15" apart; gradually earth up after covering the stems with a roll of paper	The ground must be specially rich, and frequent watering is necessary	8 to 10 days	16 to 18 weeks
Potatoes	Sir John Llewellyn, Edward VII., Up-to-date, Factor	March	7 lbs. to 40 ft.	8d. to 4s. per 7 lbs.	Earlies 4" Lates 6"	1 ft. apart in rows 2 ft. apart for earlies; 1 ft. by 2½ ft. 2nd earlies; 15" by 3 ft. main crop	Trenched at least 3 ft. and well manured. Soil for potatoes should be very rich, well sweetened by constant working, and the use of lime and superphosphate is recommended before planting	—	14 to 20 weeks earlies, 18 to 20 weeks lates
Vegetable Marrows and Ridge Cucumbers	Pen-y-byd, Long White, Custard, Moore's Cream (veg. mar.); Success, (ridge cucumbers)	February in heat. Outside in May	½ doz. plants	3d. to 1s. per pkt.	The roots firmly planted in shallow depression	12 yds. apart, or 15 sq. yds. for a plant	The soil should be deeply cultivated and enriched. A manure pit or hot bed is by no means necessary, and is of little if any advantage	7 days	15 to 18 weeks
Tomatoes	Holme's Supreme, Lockie's Perfection, Best of all, Early Ruby	From January to May in gentle heat	1 oz. seed produces 2000 plants	6d. pkt.	Do.	3 ft. apart when planted out	The ground should not be rich at first, but after the fruit begins to set, manurial waters and mulchings of dung will be found of great value	7 to 9 days	16 to 18 weeks after seeds are up
Winter Greens	A1. (kale), Leamington (broccoli), Matchless (sprouts), Dwarf Green (savoys)	March or April in seed beds. Thin out and transplant to permanent quarters in May	1 oz. seed produces up to 2000 plants.	3d. pkt.	Do.	Allow fully 2 ft. each way	The ground should be rich and deeply trenched. Planting between rows of potatoes may be done, provided they are wide enough apart to avoid the plants being drawn	7 to 9 days	6 to 9 months
Cauliflowers	Autumn Giant, Eclipse	April	Do.	3d. pkt.	Do.	2 ft. each way	A moist position and a not too rich soil is best	7 days	15 weeks
Spinach	Standwell Summer, Standwell Winter	From February onward for succession	½ oz. to 40 ft.	4d. to 6d. per oz.	1"	Thin out to 6" apart, rows 18" apart	Well cultivated soil is necessary for best results	7 to 9 days	10 to 14 weeks
Shallots	Jersey Giant	January	2 lbs. to 40 ft.	6d. per lb.	Nearly cover the bulb	9" each way	The ground must be good and well cultivated. Let the bulbs ripen well	—	6 to 8 months
Lettuce	Paris White (Cos), All the year round (cabbage)	March to July	1 oz. gives 2000 plants	3d. pkt.	½"	6" by 12"	Any well cultivated soil	7 days	10 weeks
Radish	French Breakfast	February to May	½ oz. to 40 ft.	3d. pkt.	1"	Thin out to 3"	Do. Do.	7 days	5 to 6 weeks
Endive	White Batavian	March, April	1 oz. gives 2000 plants	6d. pkt.	½"	9" by 12"	Do. Do.	7 days	10 to 12 weeks
Parsley	Best Curled	March, June	½ oz. to 40 ft.	3d. pkt.	—	—	Do. Do. Generally grown along a border	7 days	12 weeks

N.B.—Leeks and Celery, as well as Vegetable Marrows and Ridge Cucumbers, are combined because the method of culture is practically identical in each case, although of course the crops are separate and distinct.

REGULATIONS FOR SECONDARY SCHOOLS.

GEOGRAPHY—(*continued from page* 418).

SECOND YEAR.—TERM II.

(*A.*) THE AMERICAS IN GENERAL.

Introductory.—The discovery of the New World by Columbus. The exploration of the Venezuelan coast by Amerigo Vespucci in 1499. He wrote the first narrative of his own discoveries and those of Columbus, and hence his name given to this great division of the globe instead of Columbus, who was the more entitled to the honour.

General View.—Comparison with other great land masses. In area (16½ million square miles) America ranks next to Asia, four times Europe, larger than Europe and Africa together; in political and commercial importance, second only to Europe. Note interesting points of contrast and comparison with Eurasia, *e.g.* America's greatest length north to south, 9000 miles. The greatest mountain chains extend from north to south; the great plains open to the ocean (*cf.* Eurasia's greatest length and direction of principal mountains west to east, and the immense plateaus remote from influence of the sea). The New World runs through four zones (*cf.* Eurasia chiefly in the North Temperate Zone). From the heart of the two Americas are great arteries to the ocean (*cf.* the closed basin of Central Asia). America is the land with a future of untold possibilities; Eurasia points to much accomplished work, the product of past ages. Compare the two Americas. In shape both are triangles, South America by far the more regular. The western coast of each is marked by high ranges of mountains, the east coast of each by lesser elevations. In each there is a central plain of vast extent; the northern one drained by the St. Lawrence and the Mississippi, flowing east and south respectively; the southern one drained by the Amazon and La Plata, flowing east and south respectively.

Compare South America with Africa. Note the few indentations in each. Where South America bulges out Africa tends inwards. South America's lack of broken coast atoned for by rivers, in great contrast to Africa's mainly inaccessible centre. South America's lack of lakes compared with Africa; but the Amazon pours out more water than Nile, Zambesi, and Congo combined. In South America vegetable life is more developed than animal (*cf.* Africa's large and strong forms of animal life).

Both North America (9,000,000 square miles), and South America (7,000,000 square miles), continental in magnitude. The varying width of the continent from 3200 miles to 28 miles at narrowest point of isthmus of Central America. Note the extreme points of the mainland.

North America.

Coast.—Washed by three oceans. Total length 24,500 miles—one mile of coast to 350 square miles. The Arctic coast—its principal channels and islands. The search for the North-West Passage; William Baffin in 1615, Franklin, M'Clintock, Parry, M'Clure, Greeley, and others, down to Peary in recent times. The death of Hudson. The sterile coast of Labrador. The Labrador Current. Newfoundland. Gulf of St. Lawrence. Fogs. Icebergs. Cape Breton and Prince Edward Islands. The Bay of Fundy and its phenomenal tides. The Atlantic coast opposite to the direct route to the busiest and most progressive peoples of the Old World. The eastern coast of the United States less bold, gradually diminishing to the low coast of Florida, and the sandy, swamp-lined coast of the Gulf of Mexico. The Gulf of Honduras, Central America, the West Indies, Isthmus of Panama. The Pacific Coast generally bold and rugged.

Surface.—Note the gigantic scale of the mountains, rivers, and lakes. The three great features in the relief of North America: (1) The Pacific Highlands; (2) The Great Central Plain; (3) Atlantic Highlands, the Alaska Heights. The Rockies, and the succession of plateaus and lesser ranges to the coast. The elevated plateau of Mexico. The outstanding feature of the Great Central Plain is the prairie or natural meadow region.

The four great rivers—St. Lawrence, Mississippi, Yukon, the Mackenzie. Western portion of continent inadequately supplied with rivers compared with eastern. Discuss the chief rivers from point of view of commercial utility. The value of the St. Lawrence and the Mississippi compared with the Mackenzie. The Rio-grande-del-Norte. The Fraser, the Colorado, and the Grand Cañon. The lakes surpass those of other continents in number and size. Discuss in detail the Great Lakes as a commercial highway. The labyrinth of lakes and river channels in the north. Great Salt Lake in Utah. Lakes Chapala in Mexico and Nicaragua. Note the trifling elevation of the land that separates the basins of many of the great rivers.

Climate.—Extending over 55° of latitude, great variety of climate. Broadest parts of North America stretch into the higher latitudes, and hence colder than corresponding latitudes of Old World. Eastern coast colder than western. Liable to great extremes of heat and cold. Compare temperature of Quebec and Paris, Labrador and Britain. Mean temperature of United States 53° F., or little higher than London. The Indian summer of New England States. Tornadoes and blizzards. The intensely hot summers and mild winters of the Southern States, especially on Gulf of Mexico. The tropical climate of West Indies and Central America.

Natural Productions.—The great forest wealth. The useful timbers of Canada and the United States. The characteristic trees of the Southern States. The mahogany, rosewood, ebony, and other cabinet woods of Central America and the West Indies.

The great wheat lands of Canada and the United States. The maize crop. Cotton, tobacco, sugar in warmer regions of the States and Mexico. Florida oranges. Fruit cultivation, especially in Canada and California. The tropical products of the West Indies.

The fur-bearing animals of the north. The seal fisheries. North America rich in minerals. Immense coalfields. Vast deposits of iron ore. Silver. Gold. Other useful metals. Petroleum.

South America.

Coast.—Vast peninsula, ocean-washed except for some 40 miles of isthmus: 15,000 miles of coastline; 1 mile to every 435 square miles (*cf.* Europe, 1 mile

coast to 90 square miles, and Africa, 1 to 750 square miles). On Atlantic coast most of the openings are mouths of rivers. Few good harbours. Mangrove swamps between mouths of Orinoco and Amazon. Reefs troublesome to shipping off the elbow of Brazil. Caribbean Sea.

West coast steeper and still more unbroken. Does not face energetic peoples and busy markets, as does the east coast. Except for West Indian archipelago, remarkable deficiency of islands. Falklands. Juan Fernandez. The Galapagos.

Surface.—Vast plains in the centre. The Andes. Minor elevations on other side of the triangle. Both mountain systems gradually slope inland, with much steeper slope seawards, hence the great rivers of the central plains, and the unnavigable streams of the coastal regions.

The Andes, the backbone of the southern continent. Three times as long as the Himalayas, more uniformly high and unbroken. Treble chain in the north, double in the centre, single towards Cape Horn. Throughout their length Andes rise above line of perpetual snow. In Patagonia 8000 feet, Aconcagua 23,000 feet, and quite a dozen peaks are 4 miles high. Note great number of active, or recently active, volcanoes: Cotopaxi and Chimborazo. Discuss in detail the northern and eastern highlands. Selvas. Llanos. Pampas. Atacama Desert. Shingle desert of Patagonia.

Enormous possibilities of inland navigation. In all seasons Orinoco and Amazon connected, *via* Rio Negro and Cassiquiare; Amazon and the Plate rivers linked up in wet seasons by the Madeira and Paraguay. Amazon has greatest basin and volume of any river of the world. Drains 3,000,000 square miles (*cf.* area of Canada), and with its tributaries affords 50,000 miles of navigable waterways. Estuary 200 miles long. Tide affects main streams for 400 miles. Fresh water discharged is easily distinguishable 150 miles out at sea. Steamers ascend almost to foot of Andes. Commercial value of Amazon discounted by small population in its basin.

La Plata, second in volume only to the Amazon and Congo. From aspect of commercial importance compare with Mississippi. Drains areas differing in climate, and hence traffic is marked by variety of products (*cf.* Amazon's similarity of products along its entire course).

Orinoco, liable to disastrous floods. Its unhealthy delta. Ocean vessels ascend 250 miles; river steamers can proceed a further 1400 miles.

On Pacific Coast not a single river of commercial importance; but the glacier-fed torrents industrially important for supply of water power.

South America, remarkably destitute of lakes.

Climate.—South America is the continent of moist heat. It lies mainly within the tropics, and receives the maximum of heat; but all the year round the north-east and south-east trade winds blow into the heart of the continent. Eastern ranges of mountains act as condensers and denude the trade winds of a great deal of moisture, which work the Andes effect still more completely. Enormous rainfall shown by the volume of the rivers. Robbed of moist winds by the Andes, on the Pacific Coast are large areas of desert. Note the dense forests in tropical area protect the surface from the sun. Great areas of mountain land also modify the natural heat. At 10,000 feet above sea-level in the tropics the climate is perfect; Quito, on the equator, has a climate of perpetual spring.

Natural Productions.—The heat and moisture give rise to marked luxuriance of vegetation. Forests of Guiana and Brazil, for extent and density, unequalled by any other forest region in the world; mahogany, Brazilwood, logwood, caoutchouc or india-rubber tree, etc. Sugar-cane, coffee, cotton, cacao, rice, tobacco, manioc, banana are the chief products of the warmer regions. Argentine wheat field. Note cinchona and maté shrub of Paraguay.

Few large mammals, but immense reptiles, as the boa constrictor, alligator, etc. Numerous species of monkeys. The llama and alpaca representative of the camel species. Brilliantly coloured birds. Endless variety of insects.

South America is the continent of precious metals and precious stones. Useful metals abundant, but mining methods are crude compared with other great mineral regions of the world.

(*B.*) The Americas in Detail.

North America.

British North America.—Area. Coasts. Surface. Point out areas that, owing to climatic conditions, are unsuitable for settlement. Four river systems:—(1) The St. Lawrence; (2) the Nelson River, draining Lake Winnipeg, thus taking waters of Saskatchewan, Assiniboine, and Red River into Hudson Bay; (3) Mackenzie, draining the northern lakes; (4) The Fraser. The three lake systems:—(1) the Great Lakes; (2) Lake Winnipeg, etc.; (3) the Northern Lakes. The Niagara Falls. The Rockies. The provinces—the two new provinces, Alberta and Saskatchewan, inaugurated September 1905. The Alaska boundary. Newfoundland, outside the Dominion.

Climate, Soil, Productions.—The climate healthy, but marked by extremes. Summer heat as much as 90° in the shade, or nearly as hot as India. Winters severe, but dry and bracing (*cf.* the dampness of British winters). The winters of the Pacific slope not so long or severe. The prairies—the ascending levels to the Rockies, and the "barrens" in the north. No obstructions to vehicles for 1000 miles.

The forests quite 7¼ million square miles. Furs and skins. The Hudson Bay Company.

Industrial Characteristics.—Agriculture. The almost unlimited wheat-growing capacity of the country. Manitoba, the wheat field of the world. Maize, a heavy crop. Tobacco, increasing importance. Fruit cultivation, especially vine and apple. Maple sugar. Stock-raising. Dairy-farming, Canadian cheese. Facilities and advantages offered to settlers. Discuss life of a settler. Describe the gigantic operations of wheat cultivation—elevators.

Forestry. Lumbering. River timber transport. Rafts. Sawmills. Constructional woodwork for export. Wood pulp.

Minerals.—The immense resources. The chief coal areas; the development of the Nova-Scotian fields. The abundance of excellent iron ores. Sault St. Marie, Sydney (Cape Breton), and Belle Isle.

Fisheries.—Chiefly confined to western provinces. Cod and lobsters of Nova Scotia, herrings of New Brunswick, trout of Ontario—great salmon fishery of British Columbia. Newfoundland cod fishery.

Communications.—Brief history of the Canadian

Pacific Railway. Railways of Canada 18,000 miles in length, carrying 21½ million passengers and 36 million tons of freight per annum. Trace journey from Halifax to Vancouver *viâ* Quebec and Montreal. Note connection of Canadian lines with the United States railways from Winnipeg *viâ* Portal. Recent northern extensions and new lines projected and constructing.

The importance of the great lakes and St. Lawrence waterway. Canals (Welland, Lachine, Cornwall, and Rideau), to avoid natural obstructions and allow vessels from Port Arthur to reach ocean without breaking bulk. Winter snows as a means of communication in more remote regions.

Trade and Commerce.—The increase of manufacturing industries. Imports and exports, especially distribution and value of exports. Preferential trade with Great Britain.

Historical.—The red man, past and present. The French occupation, and the French colonists of to-day. Cession to Britain in 1763. Retention of St. Pierre and Miquelon as fishing stations. French Shore difficulty in Newfoundland only settled in 1904. Rebellion of 1837–8. Red River rebellion, 1869. Canada's share in the South African War.

United States.—Area. Coasts. Surface. Rocky Mountains, Yellowstone region, and Yosemite valley. Great Dismal Swamp. Staked Plains of Texas. Everglades of Florida. The short streams of the Atlantic coast. The Mississippi and its tributaries; length of navigable streams, 30,000 miles; tendency to floods; value as a great commercial artery. Colorada river. Great Salt Lake.

Climate.—Four great climatic regions; (1) Eastern coasts, cold in the north, gradually warmer towards Florida; (2) the Gulf region and lower Mississippi, warm and suitable for growth of subtropical plants; (3) the highlands of the interior subject to extremes of heat and cold; (4) the equable Pacific Coast region. The Northern States experience terrible blizzards. Discuss the effects of the Labrador Current, Gulf Stream, and Japan Current. The Chinook Wind.

Industrial Characteristics. — Agriculture the chief occupation. The great cereal crops, especially wheat and maize. The wheat pits of Chicago and New York (*cf.* the Baltic and Mark Lane Exchange, London). Cotton planting; 14 cotton States, all on Gulf of Mexico or Atlantic coast; sea island cotton. Lancashire's dependence upon American cotton, and the effect of artificial inflation of prices by speculators. The attempt to obtain cotton grown within the British Empire. Tobacco; Virginia and Kentucky yield nearly half the world's crop. Rice. Sugar. Fruit cultivation and canning, especially California.

Stock-raising. Cattle ranches and cow-boys. Cattle on the plains all through the winter; bunch and buffalo grass, converted into hay by the sun, remains on the ground for fodder in winter. Forty-four million cattle, or four times the number in British Isles. Sheep do not thrive so well in United States, about same number as in Britain; 40 million hogs. The meat trade. Great abattoirs of Chicago.

The timber industry; giant trees of California. Mining. Vast deposits of coal; annual output now first in the world. Other useful minerals. Silver of Nevada. Gold of California. Petroleum of Pennsylvania and Texas; oil gushers; and pipe lines. The Standard Oil Company. The fisheries.

The amazing rise of manufactures. Iron and Steel. Describe Pittsburg and neighbourhood; Carnegie Works.

In 1884 Great Britain produced nearly four times as much pig iron as the States; Great Britain now produces 10 million tons, and the States twice as much. Great cotton manufactures, but chiefly for home consumption. Americans noted for ingenuity in the production of labour-saving machinery, tools, etc., *e.g.* printing machines, harvesters, linotype, typewriters, sewing machines, phonographs, etc.

Communications. — Railways about 200,000 miles necessitated by the vastness of the territory and need for quicker transport than even good natural waterways provide. The four great transcontinental lines. Trace routes on each from coast to coast. Compare freight rates with those of British railways. American steel bogie cars of 50 tons capacity (*cf.* British wagons of 10 tons).

Lake Michigan, the great outlet for the Northern States. At Duluth a "whaleback" may load with 95,000 bushels of wheat, or steel rails from Pittsburg, and proceed direct to Liverpool. The Mississippi carries an enormous traffic. The great Atlantic ferry; Atlantic greyhounds. In 1843 steam passage occupied fifteen days; now it is one-third the time.

Trade and Commerce.—American progress, one of the wonders of modern trade. Dingley and McKinley tariffs. Discuss the competition of United States with Great Britain in the home market and the markets of the world. Point out that the States, with greater natural resources and larger population, must of necessity exceed Britain's total trade in bulk, although per head of population it may still be of less total value. Analyse trade with the United Kingdom. Note bulk of trade is carried by British ships. American ships cost 25 per cent. more to build than British. Purchase of White Star and other lines by American speculators; the unsatisfactory result to America.

Miscellaneous.—Government; Washington and the White House; noted Presidents. Population; noted Americans. Indian reservations. Chief towns, especially the great centres of commercial activity.

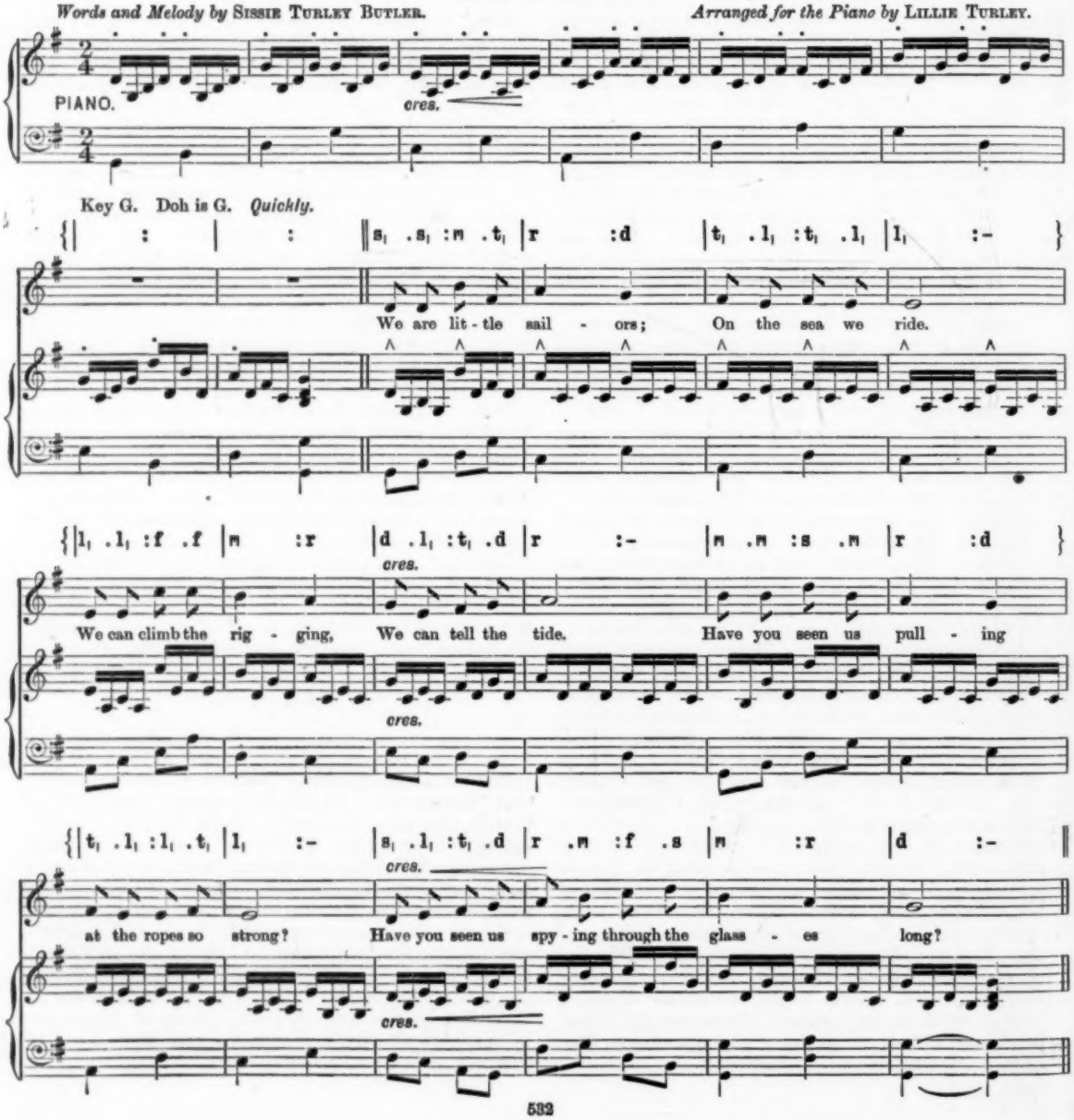
Historical, etc.—American colonies in reigns of Elizabeth, James I., and Charles II. Pilgrim Fathers. War of Independence, 1776. Civil War. Abolition of Slavery. War with Spain. United States foreign possessions. Position of the United States among the great nations of the world.

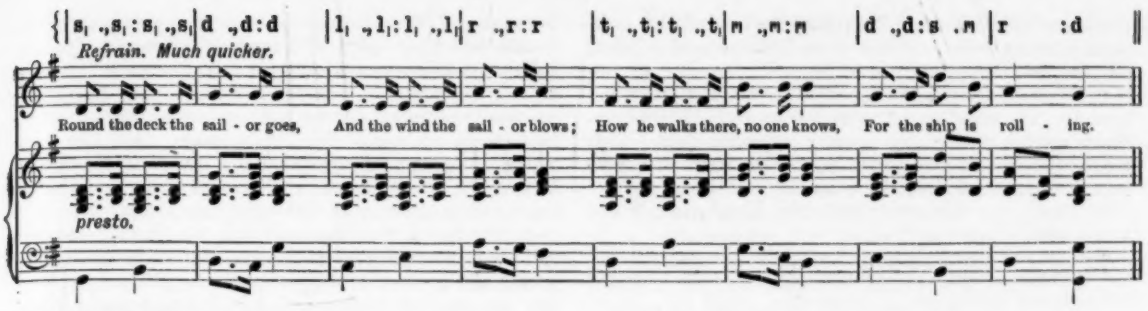
(*To be continued.*)

English Lady Student Teachers in France.—The next Examination for English student teachers in French Training Colleges will be held in London during Easter week. The students who enter these posts pay £16 into the college funds, and devote a certain amount of time, not exceeding ten hours a week, to conversing in English with the French students. In return they receive board and lodging, and the permission to attend all the classes in French history, literature, etc., held at the College. Forms of application may be obtained from the Director of Special Inquiries and Reports, Board of Education Library, St. Stephen's House, Cannon Row, London, S.W.

THE SAILORS' SEA SONG.

GAME OR SONG.

Words and Melody by SISSIE TURLEY BUTLER. *Arranged for the Piano by* LILLIE TURLEY.

PIANO.
cres.
Key G. Doh is G. Quickly.
We are lit - tle sail - ors; On the sea we ride.
cres.
We can climb the rig - ging, We can tell the tide. Have you seen us pull - ing
cres.
at the ropes so strong? Have you seen us spy - ing through the glass - es long?
cres.


Refrain. Much quicker.
Round the deck the sail - or goes, And the wind the sail - or blows; How he walks there, no one knows, For the ship is roll - ing.
presto.

All stand in a ring and sing, with appropriate actions.

We are little sailors, on the sea we ride;
We can climb the rigging, we can tell the tide.
Have you seen us pulling at the ropes so strong?
Have you seen us spying through the glasses long?

All turn and march round ring smartly with slight roll. Tune of Refrain to be repeated.

Round the deck the sailor goes,
And the wind the sailor blows;
How he walks there, no one knows,
For the ship is rolling.

Teacher says, "Sailors, climb." All, still marching, climb with hands.

This is how the sailor goes,
When the wind the sailor blows;
How he climbs there, no one knows,
For the ship is rolling.

Teacher says, "Sailors, spy." All, marching, shut one eye and pretend to hold glass to the other.

This is how the sailor goes,
When the wind the sailor blows;
How he spies there, no one knows,
For the ship is rolling.

We are little sailors, on the sea we ride;
We have been to countries, where black men reside.
In our ship we carry silk and tea for home;
Guns we have to help us, if a foe should come.
Round the deck the sailor goes, &c.

Refrain may be lengthened ad lib. by introducing other actions—pulling ropes, washing decks, &c.

POETRY AND THE INFANT SCHOOL.

BY J. EDWARD PARROTT, M.A., LL.D.

WE have taught our people to read, but we have not taught them to love letters. We have taught them to acquire information and entertainment from the printed page, but we have not taught them to recognise themselves as the heirs of the literary ages and to prize the highest, the noblest, and the best in their heritage. This is an era in which the cheap, the common, and the ephemeral overwhelmingly attract. The average twentieth-century man has decided that the loftiest things of life and art call for too great a strain upon his mind. He wants to be comfortable, and he is most comfortable with the cheap and the common. He prefers his literature in its shirt-sleeves, with its slippered feet on the fender and its clay pipe in its mouth. Let it come decorously attired, its air ambrosial, its gait a rhythm, speaking in melodious numbers of the great elemental things of life, death, and the great for-ever, and, in his own delightful phrase, he has "no use for it."

Popular appreciation of the best poetry was never at a lower ebb than it is to-day, and this every lover of letters constantly deplores. It seems to me that teachers can do much to counteract this state of decadence, and that the process can be begun in the Infant School. Nor are heroic methods necessary.

First, let us ask, What is poetry? and then, Why should it be loved and fostered?

Well, as to the first question, it is much easier to say what is not poetry than what is. Many writers have laboured at a definition, and most of them have only made the obscure obscurer. A definition is usually a delusion, and—if I may be permitted to stray from my subject for a moment—I should like to quote from the pages of that great, if unconscious, educationist, Charles Dickens, a passage which mercilessly parodies the vice of demanding definitions from the young.

"*Mr. Gradgrind* (to Sissy Jupe, who has been born and bred amongst horses). 'Give your definition of a horse.'

(Sissy Jupe thrown into a state of alarm by this demand.)

"'Girl number 20 unable to define a horse,' said Mr. Gradgrind for the general behoof. 'Girl No. 20

possessed of no facts in reference to one of the commonest of animals! Some boy's definition of a horse. Bitzer! yours.'

"*Bitzer.* 'Quadruped, graminivorous, forty teeth—namely, 24 grinders, 4 eye teeth and 12 incisors. Sheds coat in spring; in marshy countries sheds hoofs too. Hoofs hard, but requiring to be shod with iron. Age known by marks in mouth, &c., &c.'

"'Now, girl No. 20,' said Mr. Gradgrind, 'You know what a horse is.'"

Similarly, I might give you Mr. Watts Dunton's definition of poetry:—

"Absolute poetry is the concrete and artistic expression of the human mind in emotional and rhythmical language";

and add triumphantly, "Now you know what poetry is." But do we? Let us come out of the quagmire of definition and tread the solid ground of plain description. First of all, poetry is writing in verse or metre. To the poet verse or metre is the proper medium, just as colours are to the painter and clay or marble is to the sculptor. Metre is essential; rhyme a mere ornament suited to certain forms of song in certain languages.

The poet *must* possess a certain mastery over the instrument of verse; he must be such an adept in its use that the very melody flowing from his arrangement of words gives his hearers a sensuous pleasure and stirs them deliciously by its appeal to the ear. But, after all, though a mastery over and a display of metrical adroitness is necessary, and alternations of rhyme or mellifluous assonances or alliterations are legitimate decorations, the secret of true poetry must be sought elsewhere. Diction is a radical part of it. The language of poetry must not be the language of the market-place, not the curt, concise, and often slipshod speech of everyday life; not the starched and self-conscious wording of written prose, but the artistic language of emotion, of lofty truth, and high seriousness.

Let me quote Mr. Gosse: "It is absolutely necessary for the reader of the great poetry of the world to realise the solemnity of the poet's mission. He bends to entertain and even divert us, but this is only in his easier moments. In him some of the old prophetic spirit lingers; he does not approach the public cap in hand, but he pronounces august truth, involved in forms of perennial beauty, which are just as true whether mankind appreciates them or not. The poet emphasises the charm and mystery of nature, but he himself is more than any scenery;

> 'He murmurs near the running brooks
> A music sweeter than their own;'

he takes the elements of the material world, and acts with them not as an analyser, but as a master, since

> 'Out of these create he can
> Forms more real than living man,
> Nurselings of immortality.'"

Now I think we begin to perceive the elements of real poetry in so far as they are necessary for our particular purpose, viz., a metrical writing couched in the language of emotion, wrought into a form of perennial beauty, and emphasising the charm and mystery of nature.

And now for the second question. Why should we foster a love of poetry—the best poetry? Well, first, because, as Wordsworth phrases it, poetry is "the breath and finer spirit of knowledge;" because poetry interprets life as nothing else can; because it has a mysterious power of forming, sustaining, and delighting us, comparable in degree with no other art of man; because it embodies the really permanent, the universal, and the elemental in a form of perpetual beauty. I quote again: "The soul is kept alive by incessant reminders of the existence of its two great inspiring forces, the Heavenly and the Earthly Beauty. All that we call good and wise and desirable moves under the sway of the imagination. Virtue itself is not passive, but active, and is the direct result of the identification of the soul with what is beautiful. . . . The more intense is the impression of moral beauty, the more impassioned will be the appreciation of the purest and most perfect verse." And may we not say, conversely, that an appreciation of pure and perfect verse fosters a sense of moral beauty in the appreciator; its very purity and perfection act as a prophylactic against the creeping paralysis of the common, mean, and base, both in thought and language.

And this brings me down from the lofty heights of Parnassus to the valley garden of the Infant School. What can we do in the kindergarten to implant a love of the highest and best of poetical achievements in the minds and hearts of little children? Not much, the sceptic may say. You talk a great deal about the elemental, the universal, the permanent, and the perennially beautiful. What have these things to do with babes and sucklings? Let us see.

Every teacher here knows full well the irresistible appeal which metre and rhyme make to the little ones. A rhyming couplet fascinates them; it lays hold of the infantile memory like a limpet on a rock, and just as physically the children love concerted movements, so linguistically they love metrical forms. Nowhere is verse more at home than in the kindergarten; it is the very atmosphere and sunlight of the Infant School. Every infant teacher recognises the fact, and rightly lays the greatest stress on the memorising of poetry by children. The question I wish to ask is, "Do we consciously choose the verses which our charges learn with a view to fostering in them a love of the highest, the purest, and the best in poetry? Do we deliberately attempt to lay the foundations of a pure and refined taste for the best things of literature and life? Are we not, too often, content with a merry jingle derived from a ready-made selection—a childish joke in baby language—a something which only gives momentary pleasure, and has no intention of serving the future hour? Do we make the choice of verses for repetition a matter of conscience, an index of our own taste and refinement, a stepping-stone towards the best?

If infant teachers would choose, with cultured discrimination, the poetical pieces which their charges are to commit to memory, they would be doing a great work for the literature of the future. The mind of the little child is in the most receptive state; its acquisitions will last until the "crack of doom," and when time runs back "to fetch the age of gold," it ought to have gems of the first water to recall. As I write, I have a vision of a dear old lady, who in her green old age used to repeat, for her solace, joy, and strength, the many beautiful little poems which she had learned in early childhood. Her literary taste was excellent. The jewels in her casket were few, but they were flawless. They were to her a standard by which to judge all the

poetry that she subsequently read. Fallacious estimates of the unworthy and the untrue in literature were impossible to her, for she had, as part and parcel of her mind, an amulet which served as a charm against the doubtful and merely pretentious. For her had been done unconsciously what Matthew Arnold suggests as a conscious discipline. In his *Essay on the Study of Poetry* he says: "Indeed, there can be no more useful help for discovering what poetry belongs to the class of the truly excellent, and can therefore do us most good, than to have always in one's mind lines and expressions of the great masters, and to apply them as a touchstone to other poetry. Of course, we are not to require this other poetry to resemble them; it may be very dissimilar. But if we have any tact we shall find them, when we have lodged them well in our minds, an infallible touchstone for detecting the presence or absence of high poetic quality, and also the degree of this quality in all other poetry which we may place beside it. Short passages, even single lines, will serve our turn quite sufficiently." Now I do not suggest that in the Infant School we should teach Matthew Arnold's examples of the very highest poetic quality. They can well come later. But what I do suggest is that, in considering a piece of poetry for committal to memory by our pupils, we should make it a matter of consequence to subject it to a close and careful examination, and not approve it unless it satisfies certain criteria, such as the following:—

Is it beautiful?
Is it metrically perfect?
Is its diction pure and artistic?
Will it, within its limits, serve for all time as a standard of good literary taste?

I lay the greatest stress on the first two of these questions, "Is it beautiful?" This should be the alpha and omega of your inquiry. We need not go so far as to say with Keats—

> "Beauty is truth, truth beauty—that is all
> Ye know on earth, and all ye need to know,"

but we must all agree that "a thing of beauty is a joy for ever." Now that is the main object of teaching poetry to little children—to give them "a joy for ever," an anodyne against the ugly, the deformed, the false, the disproportionate, the ephemeral; to build up in their minds a love and reverence for perfection. And this we shall do if we select for their assimilation verses which have the cardinal virtue of beauty—beauty of form, beauty of expression, beauty of subject. Your idea of beauty and my idea of beauty may be two entirely dissimilar things, for Beauty has many forms, yet in her soul is one, and if you with your refined and cultivated taste acclaim a set of verses as beautiful, you cannot go wrong in giving them to the children as a possession for all time.

Then, again, I lay special stress on the second question, Is the poem under examination metrically perfect? Long before we attempt to deal with images and ideas, the ear of a child may be so delicately attuned to the melodies of verse that it will start with a strongly marked tendency in the right direction. If a child can be made conscious of the enchantment of mere sound in listening to the reading of poetry, it is a long way on the road to an ultimate appreciation and love of the best and greatest that has been written. So do not choose verses, whatever their other qualities, which violate the rules of prosody. Do not be content with the second-best. Do not say this or that is good enough for children. Nothing is good enough for children but the very best.

On the other criteria I need not dilate; their importance, secondary as it is, is self-evident. Now, let me say a few words about a point which is constantly raised when it is proposed to select poems of a culture-value for junior pupils. Such pieces, we are constantly told, are too hard for immature minds; the children do not, cannot understand all that is in them, and it is unintelligent teaching to require them to commit to memory a form of words which they do not thoroughly comprehend. Now, as far as poetry is concerned, I should like to join issue on this point. Poetry has two main facets—form and subject-matter, and the greater of these for young children is form. So long as the form is thoroughly correct and pleasing, so long as the chosen poetry is good in itself and has a fascination for the children—and the fascination will come chiefly from the form—"it is," says the *Suggestions*, "of little moment whether or no they wholly comprehend what they learn. An element of incomprehensibility is, perhaps, part of the fascination. The pieces must, of course, have a meaning for the children, but not necessarily the full meaning." It is, indeed, very doubtful whether a worthy poem can be made to yield up its full significance without long familiarity, reflection, and wide experience of life and its problems. You are not catering for the present; you are laying up treasure for the future. The poems you give to the child should be like wine in the wood; they should be capable of developing their bouquet more and more the longer they lie captive in the memory. They should be like the widow's cruse of oil, never empty, ever full of fresh thought and new inspiration.

It cannot be said that suitable pieces abound, but they do exist in sufficiently large numbers. I will just suggest four pieces, which, in my opinion, satisfy the most exacting criteria: "The Lamb," by William Blake; "Answer to a Child's Question," by S. T. Coleridge; "Sweet and Low," by Tennyson; and "Seven Times one," by Jean Ingelow. They are delicious little things, and with them and their like we may richly freight the newly-launched barque for the voyage of life. Ah! but you will say, how hackneyed they are! True, hackneyed to you and to me; but to the child as fresh and sweet and lovely as on the day when they were first penned. I hope there does not exist the school inspector who would disapprove them on this score. If such an one does exist, let us remind him that the inspector is made for the child, not the child for the inspector.

Let us regard the mind of the child as a garden—as a garden that we love and cherish. Let us plant in it such flowers of poesy as will bring a perennial delight to its happy possessor. Let all the flowers be perfect in form and varied in beauty. As the garden grows and its bounds expand, plant here the verbena of stirring verse, there the lily of a pure idyll; yonder the pansy of a sweet thought and the violet that yields its best perfume when most overborne, and everywhere let there be "rosemary for remembrance."

Our Modern Language Section

FRENCH PRIZE COMPETITION.

RULES.

1. All translations should be **posted not later than April 8th, 1906**, and addressed:—PRIZE EDITOR, Office of the *Practical Teacher*, 35 and 36 Paternoster Row, London, E.C.
2. Competitors should cut out and send the Coupon which appears on the Back Wrapper page of the current number.
3. Competitors should write pseudonym only on MS. Prize-winner will be asked to send name and address for publication.
4. No competitor may take the prize offered more than once in three months.

A Prize of Half a Guinea is offered for the best rendering into English of the following extract:—

Je ne donnerais pas dans le féminisme qui prêche la haine du sexe fort, mais dans celui qui réclame pour la femme la participation aux affaires de ce monde. Personne n'a plus que moi l'admiration de l'homme, en tant que cerveau. Quand je le vois, jetant les piles d'un pont, perçant les montagnes, arrachant ses secrets à la nature un à un, je me sens bien petite. La lourdeur de son fardeau m'inspire même une pitié maternelle. Mais je vois aussi qu'il ne peut suffire à tout. Si la femme est nécessaire à compléter sa vie, elle est nécessaire aussi à compléter son œuvre. Elle est capable de l'aider à combattre la tuberculose, l'alcoolisme, de l'aider à créer des demeures salubres où les petits puissent croître à l'aise. Sous le gouvernement de l'homme seul, il y a trop de gens qui ont froid, qui ont faim, trop de vice aussi, trop de saleté morale. Dans notre pays l'Assistance publique est organisée de telle manière que, sur cinq francs, deux seulement arrivent aux nécessiteux . . . deux, vous entendez. Ses hôpitaux sont une honte pour la France. Il serait temps, grand temps, que la femme intervînt dans les choses qui sont de sa compétence, car elle est la mère, après tout. Elle seule doit être chargée de relever les blessés sur le champ de bataille de la vie. Elle seule doit tenir les cordons de la bourse des pauvres. Tout cela demande un apprentissage. Cet apprentissage devrait être le complément de l'éducation de la jeune fille. Nous y arriverons. La nature s'est servie de la femme saxonne pour ouvrir la voie, déblayer le terrain; elle a besoin maintenant de la chaleur d'âme, de l'idéalisme, de la féminité même de la Latine et de la Slave; elle ne tardera pas à mettre ces belles forces en action; si je ne me trompe, le mouvement initial est donné.

From "Sur la branche," by
PIERRE DE COULEVAIN.

RESULT OF THE MARCH COMPETITION.

The prize is awarded to "Thekla." (Will "Thekla" kindly forward name and address for publication?)

First Class.—Thirlestane, Hazard, D. J. M., Padova, Lemuel Gulliver, Eicarg, Danella, Resurgam, Fraisier, Phil, Hamlet, Bog Violet, Agazneg, Nosilla, Devanka, Logos, W. M. E., Aquina, Sandow, Quimperoise, Ignoramus, Josepha, Comet, Dunnottar, Lammermoor, Eypul, Through, Tyro, Outis, T. V. D., Joli Cœur, Potter, Paimpol, Bobby, Brun, Leidernot, Piscator, Madeleine, Carol, Troisième, Mergy, Norse Eboracum, E. S. L. A., Rus, Le Bédouin, Ooty, Babsie, Montrose, Shakspere, L'avare, Virgil, June, Acharn, Picciola, Kallikrates, Dareska, Winnowsty, Spenser, Sissy, Liknos, Maxwell, Golcar, Mab, Stonefield, Carpe diem, Traduzco, Summerbank, G. C., La plume, Anna, Wernfab, Sidney Carton, Tait, Whippersnapper, Chaos, Monq, Adolphus, Manasses, White Rose, Rufus, Una, Sunnyside, Togo, Glen, Birks, Cær Fyrddin.

Second Class.—Véronique, Ray, Ema, Q. E. D., Furzillian, Bassanio, Hannibal, Clodgey, Fleda, La jeune fille, Nina, Entente cordiale, Aimée, K. T. G., Héloïse, Zanzibar, Ethel, Sally, St. Serf, R. E. S., Anderson.

The name and address of "Jonathan Willeth" are:—Mr. W. H. Dann, Kenilworth, Ryde, I.W.

"Fittick's" name and address are:—Miss M. J. Washington Wilson, 54 Carden Place, Aberdeen.

Report.

Quite a number of competitors remark that "hammal" is not found in the dictionary. That is so, but the word is evidently, from the context, a word more or less local, and so need not be translated. We found it ourselves, when journeying overland to Constantinople, first applied to the porters at Bucharest. "Fez" need not have been explained by "Thekla." The quality of the papers has been well kept up. A few, curiously enough, continued throughout the piece to regard the hammal as a sort of beast of burden in the literal sense.

Prize Translation.

The hammal is a species common to Constantinople. He is a camel with two feet and no hump; he lives on cucumbers and water, and carries enormous weights along streets unsuitable for traffic, over ground rising perpendicularly, during times of oppressive heat. Instead of hooks, he has on his shoulders a small pad of stuffed leather for carrying burdens, under the weight of which he steps along bent and taking the weight on his neck as oxen do. His costume consists of wide canvas breeches, a vest of rough yellowish material, and a close-fitting *cap worn by the natives of Morocco*, surrounded by a handkerchief. Hammals have their trunks very much developed, and often, which is remarkable, very thin legs. It is difficult to imagine how these poor legs, covered with tanned skin and like flutes in their cases, can support weights which would make a Hercules succumb. Following the hammal, who was making for the lodging reserved for me, I plunged into a labyrinth of streets and narrow lanes, winding, mean, wretchedly paved, full of holes and quagmires, blocked up by mangy dogs, and asses laden with beams or rubbish. The dazzling optical illusion which Constantinople presents from afar was rapidly disappearing. Paradise was changing into a sewer, poetry was assuming the dress of prose, and I asked myself, with a certain melancholy, how these ugly ruins could affect in perspective such charming appearances—such a delicate aërial tint. Following at the heels of my hammal, and leaning on the arm of my guide, I reached the room destined for me, near the main street of Péra, bordered by buildings insignificant but tasteful, in the manner of streets of the third order at Marseilles or Barcelona.

"THEKLA."

OUR TUTORIAL SECTION

OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

Late Principal of the Belvedere Pupil Teacher Centre, First on Scholarship List; Author of "Scholarship School Management," "Building of the British Empire," etc.

SCHOLARSHIP COURSE—PART II. 1906.

Fourth Month—April.

Work to be Prepared.

I. *Composition.*—Write one or two essays each week, of from forty to fifty lines in length. Make an analysis before you commence to write, and express your ideas in the best language at your command. Always revise carefully for punctuation and slipshod expressions. Select your essays from the following topics:—

(*a*) What was gained by the English people from the Danish and Norman Conquests?
(*b*) Railway travelling in future.
(*c*) Singing birds and their enemies.
(*d*) Should the State take control of the railways?
(*e*) "The apparel oft proclaims the man."
(*f*) Modern advertising.
(*g*) "The spacious times of Great Elizabeth."
(*h*) Charles Dickens and his influence.

Notes on the subjects:—

(*a*) To understand what was gained by these conquests one must obtain an accurate estimate of the Saxon character. The intense love of freedom, the respect for law, the pertinacity of endeavour were good features; the tendency to exclusiveness, the love of drink, the gluttony in eating were the reverse. The Danes brought a new strain into the blood, and gave the English that love of the sea which has had so much to do with its development. From the Normans much was gained. The Teutonic temperament was apt to degenerate into sluggishness and bovine indifference; the lively, brighter, more intellectual Norman introduced the element needed to rescue the Saxon sturdiness from stupidity. Temperance in food, neater dress, a more elastic speech, wider interests, a love for architecture, all take their rise from the Conquest.

(*b*) The railway travelling of the future will be characterised by improvements on the present system in three directions: (*a*) greater speed, (*b*) greater comfort, (*c*) reduced cost. Possibly a fourth may be added in a different motive power, say, electricity instead of steam.

The first point will come with improved tracks, new developments in the form of traction. Speed must be accompanied by economy and safety.

As far as comfort is concerned much is now being accomplished and very much remains to be done. The continental trains are in many respects superior to English ones. The trains de luxe that run to the south of France, to Switzerland, etc., are fitted with every possible convenience, and travel is no more wearying than sitting at home. It is fairly safe to prophesy a reduced cost as new time- and labour-saving appliances are introduced.

(*c*) "Singing birds" is a very interesting subject. Tropical birds have usually gorgeous colours but no voice; Arctic birds are mainly white or grey, and do not sing; it is in the temperate climes that the sweetest singers are heard. Their lovely voices compensate for the sobriety of their colouring, for nearly all are inconspicuous in appearance and small in body. The names and habits of many will naturally occur to the student.

Their enemies are mainly birds of the hawk tribe, small carnivorous animals, such as the weasel, stoat, polecat, etc., and man. The latter either traps them to imprison them or shoots them for levying toll on his fruit and crops, forgetting that this is more than earned by the number of insects they destroy for him.

(*d*) There are many reasons for and against the Nationalisation of the railways.

For—

It would lead to a reduction of fares and tariffs.

The whole of the systems would be correlated and made to help each other.

The railways would be, like the Post Office, a source of revenue to the Government.

Other nations own the railways and make them successful.

Against—

Better service is likely to be obtained by competition between rival affairs.

The advantages might be strangled by red tape.

The great expense of purchasing all the lines.

Competition leads to a keenness which would not be found in Government officials.

(*e*) Dress is not *always* an indication of character, but it is true (as Shakespeare always is in such statements) that "oft" it does. A tendency to foppishness is generally an indication of an inferior mind. A great mind is superior to the "latest" thing in neckties or fancy waistcoats. The methodical, orderly man is bound to be neat in his dress and appearance, and good taste revolts at anything like display or eccentricity. Men of the same occupation occasionally adopt a distinctive dress, *e.g.* the horsey man is easily recognised.

(*f*) Doctor Johnson was decidedly wrong when he said that advertising had reached its highest point in his day. The ingenuity displayed nowadays in bringing articles before the notice of the public is a product of modern development and competition. Carlyle's dictum that the population of England was "mostly fools" is true as far as advertising is concerned. One needs only glance through the pages of advertisements in a modern magazine to see that many people are making money by the "gullibility" of others. It evidently pays, or the money would not be spent on advertising the infallible cures for all evils under the sun. The formidable list of testimonials (mostly bogus), the authentic statements, the offer of free samples, appeal strongly to many men, and convince them against their own reason. Not that all advertisements are false—far from it; but amidst the general clamour for notice by innocuous but useless articles, a useful one is possibly overlooked. One of the chief features of modern advertisement is the fact that it has called in art to its assistance. The eye is caught more quickly by a picture than by words, and hence famous pictures are utilised to push the sale of articles, with which they have or had no connection.

One must not omit to mention the tremendous advantages in prolific advertising—the increase in trade, the rapidity with which wants may be supplied, etc.

(*g*) The time of Elizabeth was "spacious." England had broken free from the narrow limits which had obtained during the Dark Ages. (1) There was freedom of intellect. The Revival of Learning had come, like the rising sun, to dispel the heavy mists which obscured the view, and to reveal the beauties of the wide world. The literary treasures of Greece and Rome were read and re-read, and men's minds expanded in their outlook on every branch of learning. (2) There was freedom of commercial enterprise. De Gama doubled the Cape and reached India, Columbus had discovered a new world, Cabot had further explored it; the Sea Dogs of Elizabeth were no longer confined to the narrow seas, but made their way to every part of the known world. (3) There was freedom in religion. The Reformation had removed an incubus, and men worshipped the Deity all the more truly since they could do so without the limitations and trammels hitherto laid upon them.

(*h*) Dickens's influence was undoubtedly great, and was felt more in his own days than in ours. He lived at a time when the people wanted something interesting to read—and they got it. No other of his contemporaries approached him in wit, humour, and pathos, and hence his popularity. He utilised his

power in attacking such institutions as were then abused, *e.g.* the "bumbledom," as shown in *Oliver Twist*, the wretched private schools, as depicted in *Nicholas Nickleby*.

II. *English.*—The remaining time till the examination will naturally be spent in revision. Note-books, if they have been properly kept, will be of more use than text-books. The selected books should be re-read, with special attention to their literary and artistic side.

(1) Prepare answers to the following questions where necessary.

(*a*) Analyse the following, and parse the words in italics:—

There's nothing in this world *can* make me *joy;*
Life is *as tedious as* a twice-told *tale.*
Vexing the dull ear of a drowsy man;
And bitter shame hath spoilt the sweet world's taste
That it yields *nought but shame* and bitterness.

(*b*) *Whenever* I read a book or a passage that particularly pleased me, in which a thing was said or an effect rendered with propriety, in which there was *either some* conspicuous force or some happy *distinction* in the style, I must sit down *at once* and *set myself to ape* that quality.

(*c*) Give the plurals of the following, with such notes as you think necessary to explain the rule employed: *son-in-law, handcuff, spoonful, knight-templar, governor-general, court-martial, hanger-on.*

(*d*) What adjectives do not admit of inflexion for comparison?

(*e*) What is the subjunctive mood? State and exemplify three uses of it.

(*f*) Write sentences containing the following words, followed by suitable prepositions: *similar, different, thirst, adapted, obnoxious, averse, suitable, preferable, capable, accuse, supersede, substitute, convert, call, disappointed, deal.*

(*g*) Correct or justify the grammar, etc., of the following sentences:—

(1) Every man and boy showed their joy by clapping their hands.
(2) Thine is the kingdom and the power and the glory.
(3) What sort of a man is he?
(4) On rising, he partook of a good breakfast.
(5) I cannot tell you how much pains have been spent on him.
(6) He is not only famous for his riches, but for his wisdom.
(7) More than one emperor prided himself upon his skill as a swordsman.
(8) Severe the doom that length of days impose.
(9) The Thames is derived from the Latin Thamesis.
(10) He said that he had not, and never would go, near the place.

(*h*) Use the following words in suitable sentences: lineally, rhapsodically, rhetorical, permissible, pusillanimity, ostracism, parasite, immense, sinecure.

(*i*) Who wrote these lines?—
(1) Now glory to our Lord of Hosts, from whom all glories are.
(2) Blow, blow, thou winter wind.
(3) He prayeth best who loveth best.
(4) A thing of beauty is a joy for ever.
(5) The paths of glory lead but to the grave.
(6) Ring out, wild bells, to the wild sky.
(7) Roll on, thou deep and dark blue ocean, roll!
(8) The breaking waves dashed high on a stern and rock-bound coast.

(*j*) Who wrote the following?—*Bleak House, Uncle Tom's Cabin, Hyperion, Silas Marner, Harold, Heroes and Hero Worship, Two Years Ago, Every Man in his Humour, Arcadia.*

State approximately when the author lived, and mention one other of his works.

Henry V.

(1) What conclusions, if any, can be drawn from this play as to Shakespeare's knowledge of (1) the French character, (2) the French language. Illustrate your answer by quotations.

(2) Write a character of Falstaff.

(3) Describe the Battle of Agincourt and the arrangement of the forces on the field.

(4) Give the substance of the Archbishop's argument in favour of Henry's claim to the French throne, and point out where these arguments are unsound.

(5) Give, in your own words, the substance of the King's address to his nobles immediately before the battle.

Bacon's Essays.

1. Give, in your own words, the substance of the Essay on Truth.

2. Write explanatory notes on the following:—

(*a*) Montaigne saith prettily.
(*b*) That you may have no perpetuum.
(*c*) One of the later school of the Grecians.
(*d*) Vindicative people live the life of witches.
(*e*) Cymini sectores.

III. *Geography.*—General revision. It is frequently difficult to know what to revise when confronted with a wide subject. It is impossible to re-read the whole, and much time is frequently lost either in reading what is known or in looking for what is not known. One of the best methods is to take all the important countries and draw from memory a sketch map of them; go mentally over the chief physical features, the position of towns, the productions, imports and exports. Or take the chief commodities of the world's markets, what are they, where are they produced, whither they are exported? Or, again, take the index to the text-book, and see if something is known of every name therein; if unknown, look it up. The general questions in Meiklejohn and Holden's Test Questions will also assist in revealing weak spots.

IV. *History.*—Students must be sure of *cause and effect* in History. Take leading events seriatim, and consider whether you can explain the cause which produced them and the effects which arose from them, *e.g.* the Roman, Saxon, Danish, and Norman Invasions, the Constitutions of Clarendon, Magna Charta, Provisions of Oxford, etc., the Revolt of the Villiens, the discontent in Tudor times, the Crusades, etc.; all the chief wars.

The following points should also be thoroughly known:—

(1) Genealogical tables, showing the exact descent of each dynasty.

(2) Growth of the Constitution, Witanagemote, Magnum Concilium, Curia Regis, House of Commons, etc.

(3) The origin of great movements — Downfall of Feudal System, Progress of the Church, the Renaissance, the Reformation, etc.

(4) Battles, with plans of the chief, *e.g.* Aylesford, Mount Badon, Heathfield, Ellandune, Hengest's Down, Ashdown, Ethandune, Brunanburgh, Stamford Bridge, Hastings, Genbroi, Alnwick, Tenchebrai, the Standard, Lincoln, Bouvines, Fair of Lincoln, Lewes, Evesham, Cambuskenneth, Falkirk, Bannockburn, Boroughbridge, Sluys, Crecy, Neville's Cross, Poictiers, Navaretta, Radcot Bridge, Homildon Hill, Shrewsbury, Bramham Moor, Agincourt, Herrings, of the Wars of the Roses, Stoke, Guinegate, Flodden, Halidon Hill, Solway Moss, Pinkiecleugh, Langside, Zutphen.

(5) Treaties with terms. Bretigny, Cateau Cambresis, Northampton, Wedmore, Troyes, Estaples, Mise of Lewes, Pecquigny, Wallingford.

3. Chief men—short biographies, *e.g.* Aidan, Anselm, Bede, Bonner, Cade, Cecil, Chaucer, Columba, Coverdale, Cranmer, De Burgh, De Montfort, Des Roches, Despensers, Dunstan, Eustace of Boulogne, Flambard, Frobisher, Gardiner, Hereward, Hooper, Walter Hubert, Ket, Langton, Longsword, Luther, William Marshall (Earl of Pembroke), More, Morton, Neville (Earl of Warwick), Oldcastle, Peter the Hermit, Gaveston, Sidney, Wolsey, etc.

4. Chief statutes passed, and their terms, etc.: Salisbury Decree, Inquest of Sheriffs, Assize of Arms, Assize of Northampton, Magna Charta, Provisions of Oxford, Mise of Amiens, Dictum of Kenilworth, First Statute of Westminster, Mortmain, Statute of Wales, Second Statute of Westminster (De Donis), Statute of Winchester, Circumspecte Agatis, Quia Emplores, Confirmation Chartarum, De Tallagio, The Ordinances (Ed. II.), Statute of Labourers, Statute of Treason, Præmunire, Provisors, De Comburendo Heretico, Statute of Fines, Livery and Maintenance, Six Articles, Act of Supremacy, Great Poor Law, Poyning's Law.

NOTES ON THE TUDOR PERIOD.

1. "*During the actual reign of Mary Stuart, Scotland occupied the mind of Europe in a greater degree than at any other period of its history.*" *Discuss this statement.*

The statement is true. Previously Scotland had not been a factor in European history; subsequently, by its incorporation with England, it was of comparatively little importance. During Mary's reign the whole of Europe was interested in the trend of events. The burning question was the supremacy or otherwise of the Roman Catholic religion. As Mary was the next heir to the English throne, and as she was a Catholic, the whole of Catholic Europe wished for her success, and the whole of Protestant Europe dreaded it. With England once more Catholic it was hoped that the reformed religion would be speedily stamped out in the Netherlands, in France, and in Germany. Hence the political affairs of Scotland were of vital importance to all Europe.

2. *Why do people call Elizabeth "Good Queen Bess"?*

Elizabeth, like most of the Tudors, was popular with the people. This arose from many reasons. Her Government was popular, the revival in trade and commerce also enhanced her popularity. She rewarded merit in any rank, she encouraged native industries, she trusted her people, she made royal progresses amongst them, which pleased the people and were not distasteful to the Queen, for they cost her nothing. The growth of England in power naturally pleased them, and Elizabeth's staunch upholding of English interests made her deservedly popular. The passing of the Poor Laws also tended in the same direction.

3. *Say what you can of the rise of the Drama in England.*

A note has already been given on this subject. The old Miracle Plays, Mysteries, Passion Plays, which were given under the auspices of the Church, had gone out of existence with the Reformation and suppression of the monasteries; the Drama came to take its place. (Refer to the note given.)

V. *Algebra.*—Revise carefully the theory of the rules, especially the proofs of the rules for finding the G.C.M. and L.C.M., that a quadratic equation can only have two roots, etc.

Work the following test paper:—

1. Simplify the expressions—

$$3a-2(b-c)-\{2(a-b)-3(c+a)\}-\{9c-4(c-a)\}$$

and $12\left(\frac{x+y}{2}-\frac{y-2x}{6}\right)-8\left(\frac{3y-x}{2}-\frac{3x+2y}{4}\right)$.

Ans. 0; $20x-4y$.

2. Find the product of $x^3+6x^2y+12xy^2+8y^3$, and

$$x^3-3x^2y+3xy^2-y^3.$$

Ans. $x^6+3x^5y-3x^4y^2-11x^3y^3+6x^2y^4+12xy^5-8y^6$.

If the product of two expressions be $x^8+x^4y^4+y^8$, and one of them be x^2-xy+y^2, find the other.

Ans. $x^6+x^5y-x^3y^3+xy^5+y^6$.

3. Prove the identitives—

$$(x+y+z)^3=(x+y-z)^3+(x-y+z)^3+(-x+y+z)^3+24xyz.$$

$$\frac{1}{\left(1-\frac{b}{a}\right)\left(1-\frac{c}{a}\right)}+\frac{1}{\left(1-\frac{a}{b}\right)\left(1-\frac{c}{b}\right)}+\frac{1}{\left(1-\frac{a}{c}\right)\left(1-\frac{b}{c}\right)}=1.$$

4. State and prove the rule for finding the Least Common Multiple of two algebraical expressions, and find the L.C.M. of $x^{11}+x^4$ and $x^{16}+x^7$.

Ans. $x^7(x^9+1)(x^5-x^3+x^4-x^3+x^2-x+1)$.

5. Solve the equations—

(1) $(3x-1)(4x+5)-(x-2)(2x+1)=(2x+3)(5x-2)+12$.

(2) $\frac{x-y}{3}-\frac{2y-3x}{6}=8$; $\frac{x}{6}-\frac{y}{3}=1$.

(3) $\frac{1}{x-2}+\frac{2}{x-1}=\frac{6}{x}$.

Ans. 3; 12 and 3; 3 and $\frac{4}{3}$.

6. An egg-dealer bought a certain number of eggs at 1s. 4d. per score, and five times the number at 6s. 3d. per hundred. He sold the whole at 10d. a dozen, gaining £1, 7s. 0d. by the transaction. How many eggs did he buy?

Ans. 4320.

7. The men in a regiment can be formed into a solid square, and also into a hollow square, 4 deep, the number of men in the front in the latter formation exceeding the number of men in the front of the former formation by 25. Find the number of men in the regiment. Ans. 784.

8. Solve (1) $\frac{b}{x-a}+\frac{a}{x-b}-2=0$.

(2) $\frac{x}{y}+\frac{y}{x}=\frac{5}{2}$; $x^2+3y^2=28$.

Ans. $a+b, \frac{a+b}{2}$. $x=\pm 4, \pm 2\sqrt{\frac{7}{13}}$; $y=\pm 2, \pm 4\sqrt{\frac{7}{13}}$.

VI.—*Euclid.*—Revise any propositions not known, and solve the following:—

(1) From a given point draw a straight line to a given straight line, so that it shall be bisected by another given straight line.

(2) If from the right angle of a right angled triangle two straight lines be drawn, one perpendicular to the base and the other bisecting it, they will contain an angle equal to the difference of the two acute angles of the triangle.

(3) Draw a straight line through a given point such that the part of it intercepted between two given parallel straight lines may be of a given length.

(4) Given the sum of the side and diagonal of a square, to construct it.

(5) Describe a rhombus which shall be equal to a given parallelogram.

(6) Draw a parallel to the base of a triangle, so that the sum of the lower segments shall be equal to a given straight line.

(7) The perimeter of a square is less than that of any other parallelogram of equal area.

(8) The square of a hypotenuse of a right angled triangle is equal to four times the area of the triangle, together with the square on the difference of the two sides.

VIII. *Elementary Science.*—Revision questions in Science, taken from recent papers:—

1. Describe very briefly two experiments which show that air expands when heated.

2. The steam from a boiling kettle is passed into cold water. How is the temperature of the water affected? How do you account for the results you mention?

3. A beaker contains 50 grammes of lead and 50 grammes of water, both at a temperature of 70° C. How could you prove that the water contains more heat than the lead?

4. A person stands close to a pond and views the reflection on the water of a post which stands on the opposite bank. Why does the reflected post seem upside down? Illustrate your answer by a diagram showing the paths of rays of light which proceed from various parts of the post, and, after reflection from the water, reach the person's eye.

5. Why does clear water seem shallower than it really is? Illustrate your answer by a diagram.

6. How would you exhibit to a class the action of sodium on water? What substances are produced when the action takes place?

7. Some kinds of flame give rise to much and others to little light. How do you account for this? Give examples of each sort.

8. How is lime obtained? What results may be obtained when water is poured on lime? What is lime water?

9. An unmagnetised iron bar is laid on a table. Draw a diagram to show how it becomes magnetised when it is taken up by the two poles of a horse-shoe magnet.

10. A dipping-needle is mounted in the usual way. How will it behave when its axis is placed (*a*) in a magnetic meridian, (*b*) at right angles to the magnetic meridian?

11. Into what two substances is water decomposed by the electric current? Why are these substances called "elements"? What reason have you for saying that pure water is composed of nothing besides these two substances?

12. What do you know of the chemical action that goes on in a gazogene — that is, the common soda-water machine? Why does the soda-water rush out when the handle is pressed down?

13. Describe in simple language any crystals which you have seen. Say either how these are made or where they are found.

14. Two darning-needles are magnetised so that the eye of each is the north-seeking end. They are hung up side by side each by a separate thread fastened through the eye. What magnetic action between them may be observed? How do you account for it?

15. A piece of wood is fastened to a bar magnet in such a way that the latter will float horizontally. The magnet is then placed in a basin of water. What results may be observed? What do these results teach us about the magnetic force of the earth?

16. You are provided with (*a*) a drawing-board, (*b*) a drawing-pen, (*c*) a piece of elastic with a weight fastened to one end. How would you use these things to illustrate a lesson on the inclined plane?

17. What do you mean by the resultant of two forces? State the rule for finding the resultant of two parallel forces acting in the same direction. Describe some simple experimental process by which the rule in question can be verified.

18. One-fifth of a bottle is filled with cold water, the bottle is tightly corked, the cork is pierced by a bent tube one end of which dips into the water of the bottle and the other into water standing in an open vessel. Describe the results that may be observed if the bottle and its contents are heated up to a temperature of 99° C. and then allowed to cool.

19. A shadow is usually divided into an "umbra" and a "penumbra." Explain these terms. How can you readily obtain (*a*) a shadow which is practically all umbra, (*b*) a shadow which is all penumbra?

20. A fish swims in a glass tank. A person whose eye is above the level of the water seems to see two fish. Draw a diagram to illustrate this, and give any explanation you think necessary.

21. When water is first heated, a number of small bubbles are seen. How can you prove experimentally that they are not composed of steam? Sketch the apparatus you would use. Of what gases do you imagine the bubbles to consist?

22. Each of two magnetised knitting-needles is suspended by a thread in such a way that it will hang horizontally. In what direction will each needle settle itself when uninfluenced by the other? What magnetic action between the needles may be observed (*a*) when they are hung side by side, (*b*) when they are hung with the north-seeking pole of one just under the south-seeking pole of the other?

23. What do you know about the action of sulphuric acid on (*a*) lead, (*b*) iron, (*c*) copper?

24. How do you account for the fumes that are seen when strong HCl is exposed to the air? What experiments prove that the gas which we denote by the formula HCl is composed of equal volumes of hydrogen and chlorine?

25. Two hundred cubic centimetres of oxygen and 200 cubic centimetres of hydrogen are allowed to mix together. Write down the equation representing the combination that takes place when a spark is introduced into the mixture. Which gas remains partly uncombined? How much of it remains?

26. Name five gases which have been prepared either by yourself or by your teacher in your presence. Say how each of the five can be distinguished from the other four.

(See also questions under "Candidates' Examination.")

Notes on the Examination.

I give a few rules which should be carefully observed:—

(1) Do not forget your permit to sit, and such apparatus as you will need for the various papers.

(2) Allow yourself plenty of time to reach the place of examination.

(3) Always read very carefully, and follow out exactly, the instructions issued with each paper.

(4) Do not be in a hurry, and do not waste time. Make quite sure you understand what the examiner is asking for, and answer as clearly, concisely, and tersely as you can. If you are asked for "causes," it is useless to give "results." Above all things, do not attempt to pad out your answers with unnecessary and irrelevant talk.

(5) Divide up your time carefully among the questions, so that you may have time to answer each. It is far better to answer three questions, and score 7 marks on each, than to spend a long time over one question and score 10 marks.

(6) Always revise your answers.

(7) Do not study up to the last minute; do not discuss your answers with other candidates; and do nothing to upset your mental equilibrium during the week.

PUPIL TEACHERS' COURSE.

For Candidates' Examination, 1906.

Work to be Prepared.

1. *Reading and Repetition.*—Regular practice must be taken in these subjects, with great attention to proper emphasis and modulation.

2. *English.*

(*a*) Learn ten roots and meanings each week.

(*b*) Analyse the first six lines of the following, and parse the words in italics:—

Hard by a college chimney *smokes*,
From betwixt two aged oaks,
Where Corydon and Thyrsis *met*,
Are at their savoury dinner *set*,
Of herbs and *other* country messes,
Which the neat-handed Phyllis dresses.
And then in haste her bower she leaves
With Thestylis to bind the sheaves;
Or, if the earlier season lead,
To the tanned haycock in the mead.

(*c*) Turn the passage above into simple prose.

(*d*) Point out the force of the prefixes and affixes in the following, and give in each case a word similarly formed:—Contradict, dissimilar, oppose, affix, suspend, possible, regal, armament, exultation, famous.

(*e*) Make four sentences in which the predicate is extended by phrases relating to time, place, manner, and cause or reason, respectively.

Prepare answers, if necessary, to the following:—

(*a*) Explain, with three examples, the terms—subjunctive mood, participial phrase, compound relative pronoun.

(*b*) Put each of the following in a sentence so that it shall be followed by an appropriate preposition:—different, adjacent, reconcile, conversant, absolve, dissent.

(*c*) Give some examples of collective nouns, and say which of them should be followed by a singular and which by a plural verb. Give your reason.

(*d*) What is meant by gender in grammar? Give some examples of a change in gender (1) by altering the form of the word; (2) by adding a syllable; and (3) by prefixing a whole word. Give the feminine of the following:—drake, grant, horse, sir, hero, emperor, testator.

(*e*) Name the interrogative pronouns, and give examples of the use of each.

(*f*) Explain the use and meaning in grammar of the words—abstract, transitive, opposition, concord, and demonstrative, and give an example illustrating each.

(*g*) Distinguish between moods and tenses, with examples.

(*h*) Tell the meaning and use of the final syllable in each of the following words, and say from what language each is derived:—leader, lambkin, clarify, regular, famous, saline, conversation, executrix.

(*i*) How may adverbs be classified? Give examples of adverbs in each class.

(*j*) What are auxiliary verbs? Make a list of them, and say what is the use or force of each.

Composition.—Write one or two essays each week selected from the following subjects.

Read up the subject if necessary, and prepare a skeleton outline before commencing to work. State your ideas clearly and concisely, avoiding abruptness on the one hand and verbosity on the other. Read your essay aloud after writing it; the ear will frequently detect weaknesses which the eye does not.

(1) A spring day.

(2) The character (*not* the life) of any well-known historical character.

(3) All is not gold that glitters.

(4) The races of mankind.

(5) Hope.

(6) Sweet are the uses of adversity.

(7) The sun never sets on the British Empire.

(8) Why is Europe the most important continent?

Notes:—

(1) This is an exercise in word-painting. Describe as accurately as you can what you see on such a day.

(2) Take the various features of the character—honesty, bravery, patriotism, etc. Explain how they were evinced, and quote examples from the history to substantiate your statement.

(3) Explain literally. There are many mineral compounds which appear exactly like gold, *e.g.*, pyrites, but when suitable tests are applied their true composition is revealed. Then apply the proverb to the wider affairs of life. Many things appear to be valuable which on examination prove worthless. "Appearances are deceptive" expresses the same truth in other words.

(4) Mention the five great divisions—Caucasian, Mongolian, Negro, Malay, and American Indians. Describe the chief physical and mental characteristics of each.

(5) "Hope springs eternal in the human breast," says Pope, with the greatest truth. If you think over the subject carefully, you will find that hope is the mainstay of life. Everything is done in hope. It carries us through difficulties and trials which, without it, would be insupportable. Without the hope of a future, life would not be worth living. The Greeks recognised the value of this mental attitude, and made it the subject of one of their beautiful myths. The god gave Pandora a box of gifts for the human race, with orders not to open it. Curiosity compelled her to disobey, and as the box was opened all the

contents flew away, the only one detained by the closing lid being Hope.

(6) Shakespeare's meaning is that it is only in adverse circumstances true character is developed. A man who loves a life of ease and indulgence cannot develop to his full ability. It is only by meeting and overcoming difficulties that energy, determination, and other good qualities can be evinced.

(7) Explain this, and prove it by reference to the various times of the colonies, in some of which it is always day.

(8) Though the smallest, Europe is the most important of the continents. (1) Its physical condition assists—there are no huge deserts, impassable mountains, or very remote districts; (2) the climate is temperate, and this has action on the character of the people—too great heat means laziness, too much cold a stunted growth; (3) it is the centre of the land hemisphere.

3. *History.*—The reign of Elizabeth.

Read up the notes which have been given in the Scholarship course. This reign is the most interesting of the whole period. The growth of England from a third-rate power to one of the first rank is a most important phase of history.

4. *Geography.*—Finish Asia and revise as much as possible of Europe.

For revision in this subject and History use *Test Questions by Meiklejohn and Holden*, which contains all the chief questions set in public examination.

5. *Arithmetic.*—Work any general papers. Set out your solutions clearly, and add enough verbal explanation to make your method quite clear to the examiner. Think the question carefully over before answering, to see exactly what has to be done, and use the shortest method of arriving at the answer.

Work the following (all taken from Government Papers):—

(1) How many times will $\frac{3}{7}$ of the difference between $\frac{4}{5}$ of 1s. 10½d. and $\frac{4}{11}$ of 2s. 6½d. be contained in 2s.? Ans. 69½.

(2) Reduce to decimals $\frac{1}{3}$, $\frac{2}{13}$, 5½, and explain why $\frac{3}{11}$ cannot be reduced to a terminating decimal.

Ans. $\cdot\dot{3}$, $\cdot\overline{14583}$, $5\cdot\overline{142857}$.

(3) If I divide £5000 among A, B, and C, and give A £275 more than C, and B £300 less than C, what is B's share?

Ans. £1375.

(4) State the rule for finding the L.C.M. of two or more numbers. Find L.C.M. of 2907, 5168, 7344. Ans. 139536.

(5) A question was printed: "If 42^a yds. cost £12, how much will 114 yds. cost?" the denominator of the fraction being accidentally omitted. The answer was £32. Find the missing denominator. Ans. 4.

(6) If I divide a sum of money among four girls, giving ½ of it to A, ½ of the remainder to B, ⅔ of the remainder to C, and the 5s. left to D, find the whole sum. Ans. 25s.

(7) A dealer has six kinds of teas, averaging each 2s. 8d. per lb. Four of them cost respectively 1s. 11d., 2s. 3d., 2s. 7d., and 3s. 5d. per lb. What was the cost of the fifth and sixth teas, supposing that one cost three-fourths as much as the other?

Ans. 2s. 6d., 3s. 4d.

(8) A party of men, women, and boys, 32 of each, earn £235, 4s. Find what each man, woman, and boy earns, a man earning twice as much as a woman, and a woman twice as much as a boy. Ans. Boy, £1, 1s., woman, £2, 2s., man, £4, 4s.

(9) A cistern full of water lost ·07 of its contents by leakage, and then 301 gallons were drawn off, which left the cistern half full. How many gallons did it contain? Ans. 700.

(10) 600 men were besieged in a garrison town with provisions for 35 days, allowing each man 18 oz. a day. How long would the provisions last if the garrison were reinforced by 300 men, and the daily allowance were reduced to 15 oz. a day?

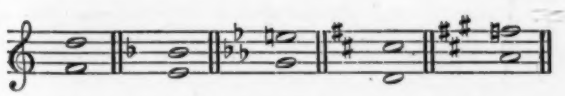
Ans. 28 days.

6. *Algebra.*—Continue working at any general test papers.

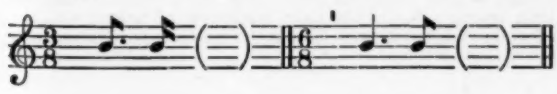
7. *Music.*—Answer the following:—

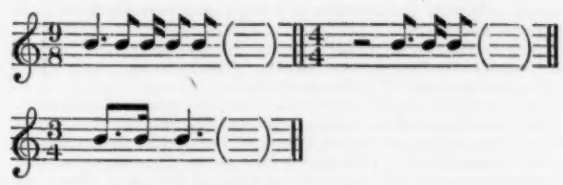
(1) Write one octave of the scales of E♭ major and A major, placing the flats and sharps necessary before the notes and not as a signature.

(2) Name the following intervals:—



(3) Complete each of the following bars by adding one *rest* at the end:—





(4) Rewrite the following passage, making a change to the first flat key at (*a*), and a return to the original key at (*b*):—

Key C. (*a*) (*b*)

m f r d s ta m f l r f d' t d' r d

(5) Name the intervals—

{fe / ray} {doh' / me} {ta / soh} {lah / doh} {fe / te,}

(6) Write distinctly over each note and rest in the following its value in pulses or fraction of a pulse:—

‖ d :m,.f | s :-. | s .,f : m., | .r : d ‖

8. Revise any of the Science not thoroughly known. Read up answers if necessary to the following questions:—

(1) What do we mean when we say that the specific gravity of mercury is 13½? What things are necessary for the experimental determination of this specific gravity? Say how you would proceed to make the determination.

(2) Part of a chain rests on an inclined plane, and the remainder hangs over the back. Draw a diagram to show in what position the chain will rest if the plane is so smooth that friction need not be taken into account. Give any explanation you think necessary.

(3) As two ships pass in opposite directions, a person on one of them throws a ball to a person on the other. How must he aim? Draw a diagram to explain your answer.

(4) What do you know about the contents of that part of the barometer tube which is not filled with mercury? What simple experimental proof of the truth of your answer can be given?

(5) One hundred grammes of boiling water are poured upon one hundred grammes of ice. What results may be observed?

(6) What do you mean by the "melting-point" of a substance? Why cannot we speak of the melting-point of glass? Contrast the melting-points of mercury, lead, and iron.

(7) Persons who live in hot countries often keep drinking-water in porous earthenware vessels. Explain the reason for this.

(8) Describe very briefly two experiments which show that air expands when heated.

(9) The steam from a boiling kettle is passed into cold water. How is the temperature of the water affected? How do you account for the results you obtain?

(10) A triangle is cut out of cardboard. Draw a figure to show how it will hang (1) when suspended by a thread fastened to one of its corners, (2) when suspended by a thread fastened to the middle-point of one of its sides.

(11) About what height does the barometer generally stand? How does the reading of a barometer at the top of a mountain differ from the reading of a barometer at the bottom? How do you account for the difference?

(12) Describe a balance. How would you find out whether a balance is true or not?

(13) A piece of ice is placed in a saucer and heated over a spirit-lamp. Describe the changes that the ice will undergo.

(14) A piece of metal weighs 19½ grammes in air, and 17½ grammes in water. What is its specific gravity?

With what apparatus, and in what manner, would you find its weight in water?

(15) Mention conditions that should be satisfied by the bulb and tube of a mercury thermometer. Give reasons for each condition that you state.

(16) A jar of oxygen, a jar of nitrogen, and a jar of hydrogen are put before you. How can you tell which is which?

(17) What is the rust of iron?

Name some metals that will not rust.

A piece of sodium is thrown into water. Describe exactly what happens.

(18) What is the weight of a cubic centimetre of water? Explain how you could find the specific gravity of a solution of salt and water.

(19) An iron rod is bent at right angles, the two arms being

equal. Where is the centre of gravity, and how could you find it experimentally?

(20) A piece of phosphorus is burnt over water under a bell-jar, whose rim dips into the water. What changes take place (1) in the jar, and (2) in the phosphorus?

(21) Describe experiments to illustrate the combustion of three different substances in oxygen. Name the compound formed in each case, and state how its existence may be demonstrated.

(22) How would you determine the centre of gravity of an iron hoop made by joining together two semicircles, one thicker than the other? Explain how the observations could be used to find out which was the thicker half of the hoop.

(23) A tube of the shape U, with both ends open, is fixed in an upright position. First we pour in enough mercury to fill the curved part; then we pour 20 c.c. of water into one arm, and 50 c.c. of water into the other. Draw a diagram to show the positions which the liquid will take up, and give any explanation you may think needful.

(24) Two bars of equal length and thickness are fastened together without overlapping, so as to make a figure in the shape T. Where is the centre of gravity of the figure?

(25) How can you obtain a compound of oxygen and iron? How one of oxygen and carbon? How one of oxygen and hydrogen? In each case name the body obtained.

(26) You are provided with a glass tube in the shape of the letter U, open at both ends. How by the use of this tube can you roughly determine the specific gravity of a liquid which does not mix with water? Take the case of oil.

(27) A sheet of cardboard of irregular shape lies upon a table. How by pushing it partially over the edge of the table can you roughly determine the centre of gravity?

(28) How can you prepare hydrogen? How would you exhibit its properties to a class? What substance is produced when hydrogen is burnt?

(29) A bottle weighs 2 ounces. When holding 3½ ounces of shot, it will just float in water; when holding 3 ounces, it will just float in oil; and when holding 3¼ ounces, it will just float in brine. Find the specific gravity of the oil and the brine.

(30) A piece of cardboard 9 inches long, and 6 inches broad, is divided into six equal squares by means of a ruler and pencil. One of the two squares that are not corner squares is cut away with a penknife. Find the centre of gravity of the remaining piece of cardboard.

9. *Spelling.*—100 words per week from *Words Commonly Misspelt.*

10. *Penmanship.*—Write a page daily in the *Practical Teacher Copy Book* for Pupil Teachers.

Test Questions.

1. Write as specimens of Copy Setting:—
   Large hand.—Khyber Pass.
   Small hand.—We go to become kings of Kafiristan.
2. What progress did the Reformation make during the reign of Edward VI.?
3. Say what you can of Northumberland and his schemes.
4. What was the "Marian" Persecution, who were the chief leaders, who the chief sufferers, and what were the results?
5. Say what you can of Persia under these heads: (1) Position, (2) Production, (3) Towns, (4) Government.
6. Draw a sketch map of the Euphrates-Tigris valley.
7. Say what you can of Batoum, Smyrna, Beyrut, Mecca, Ispahan, Elburz.

Education through Pictures.—"Hang upon the walls of the schoolroom the paintings of the great masters, and let the pupils, by acquaintance with only the best, learn to become true interpreters of art." So we read in modern educational magazines. Once again I have nothing to say against this theory; but once again I silently append an essay written in answer to the following: Describe some picture hanging near you, telling what you think the picture means.

THE ANGELUS.

"This picture was painted by Malay. It contains a man and a woman, a pitchfork, a wheelbarrow and a church steeple. The man and woman are very poor, they have been digging potatoes because they need them to live on. The potatoes look very small. Just at sunset they hear a bell ring, it is the Angelus, it means they must pray. So they bow their heads and pray for bigger potatoes."

OUR CERTIFICATE COURSE FOR 1906.

BY GEORGE COLLAR, B.A., B.SC.,

Head-Master of Stockwell Pupil-Teacher School.

Test Questions on Last Month's Work.

THEORY OF TEACHING.

1. Explain the method of teaching addition and subtraction simultaneously.
2. Divide 3284751 by 283 by the Italian method, and give the mental work of the first three steps.
3. What were the fundamental principles of Pestalozzi's method?

ENGLISH LITERATURE.

1. Who were the "Cavalier Poets"? Give an account of the works of some who are represented in the Golden Treasury.
2. Name the authors of the following extracts, and show by further quotation or reference to the context that you are acquainted with the poems from which they are taken:—

(*a*) The stars, with deep amaze,
Stand fix'd in steadfast gaze,
Bending one way their precious influence.

(*b*) The trumpet's loud clangour
Excites us to arms,
With shrill notes of anger
And mortal alarms.

(*c*) Queen and Huntress, chaste and fair,
Now the sun is laid to sleep,
Seated in thy silver chair
State in wonted manner keep.

(*d*) Thou art my life, my love, my heart,
The very eyes of me,
And hast command of every part
To live and die for thee.

(*e*) Let old Timotheus yield the prize
Or both divide the crown;
He raised a mortal to the skies,
She drew an angel down.

ENGLISH HISTORY.

1. Give an outline of the course of the French Revolution up to the death of Louis XVI.
2. What were the chief principles advanced at the French Revolution, and how did the Revolution affect the course of English history in the nineteenth century?
3. In what ways was the British Empire extended as a result of the Napoleonic wars?

GEOGRAPHY.

1. Describe the principal industries of Canada.
2. Account for the importance of Montreal, Victoria (B.C.), and Quebec.
3. Name the chief physical agencies by which the natural features of a country are modified. Give three examples of changes which have occurred in comparatively recent times.

ARITHMETIC.

1. State how you would teach the subject of Interest and Stocks to your children. Frame four sums which would test their progress during the year, beginning, of course, with the example of Interest most familiar to children in an elementary school. (*Cert.*)

2. A railway stockholder received one year a dividend of 3 per cent. on his stock, and paid an income tax of 4d. in the pound. The next year he received a dividend of 3½ per cent., paid an income tax of 3d. in the pound, and found that his net income was £498 more. How much stock did he hold?

Algebra.

1. A rectangular room is $6xy$ feet long and $3yz$ feet broad. Express in algebraical form the cost of carpeting the room at y pence per square yard.

2. Given that $x=2$ is a solution of the equation

$$ax^2+3ax-4=0$$

find the value of a.

Geometry.

1. Two given straight lines are each divided into two unequal parts. Prove that the rectangle contained by the two whole lines is equal to the sum of the four rectangles, each of which is contained by one part of the first and one part of the second.

Express this algebraically, and show what the formula would become if the two lines were equal and were bisected.

Elementary Science.

1. Describe the constitution of the blood and state its functions.

2. How do arteries differ from veins, and capillaries from either?

Notes and Syllabus for April.

English Composition.

Prepare essays on the following subjects, which were set in the Certificate Examination in 1904:—

1. The arguments for and against making attendance at Evening Continuation Schools compulsory by law for scholars who have left the Elementary Day Schools.

2. The reasons by which you would be guided in your choice of a daily newspaper.

3. The improvements effected in agriculture during the last thirty years by scientific inventions.

Principles of Education.

Finish Chapter XII. of Collar and Crook's *School Management*, and in particular notice how the general principles of teaching—such as proceeding from the known to the unknown—may be applied to the teaching of arithmetic.

In the present state of public opinion respecting the necessity for attending to the physical well-being of our school-children, certificate candidates should pay the closest attention to all that is set out in the fourth paragraph of the syllabus (Section B). The text-book should be either Carpenter's *School Hygiene* (W. B. Clive), or Newsholme's *School Hygiene* (Swan Sonnenschein), but these must be supplemented by any literature on the subject that comes to hand, not omitting such material as the parliamentary debates on school dinners.

The hygienic conditions of schools may be separated into two classes: (*a*) those for which the public authorities are responsible, and (*b*) those for which parents and pupils are responsible. The teacher shares the responsibility in both cases to a greater or less extent. Among the former class of conditions are: (1) the situation, plan, and construction of the school buildings; (2) the furniture and equipment of the school; and (3) the nature and arrangement of the school work. Among the latter are: (1) food and rest; (2) personal habits of the pupils; (3) home and social environments.

The building should be on high, gravelly, well-drained soil, and while it should be easy of access from all parts from which the pupils are drawn, it should be so far removed from main roads and railways as not to suffer from the noise of the traffic. The London County Council has recently requested the Borough Councils to use wood in paving the roads outside the schools when next the roads are repaired, but the necessity of such a request shows that the sites of many London schools were ill-chosen in the first instance. The site should include ample playground accommodation, and, if possible, a little space for shrubs and flowers.

The immense cost of land in large towns makes it almost imperative to build schools of more than one storey; but they should never exceed three storeys in height, and there should be a concreted basement, part of which can be divided off to form storage room for chairs and bulky matter which is only occasionally used, and the rest might be used as a sort of small covered playground. Block floors are best for the halls, corridors, and classrooms, but the blocks should be laid on concrete and set in pitch to prevent the dust from working under them. If a block gets loose, the dust soon accumulates and raises it above the level of the others; it should be attended to at once, as it is liable to trip children up.

The size of the classroom depends on the number of children and the allowance per child. The minimum floor space allowed by the Board of Education is ten square feet per child at present, but the older rules allowed of greater crowding, and some schools still come under the old rules. In America sixteen square feet of floor space and 250 cubic feet of air space is considered a minimum. The cubic space per child must, however, be related to the system of ventilation employed. If the air is frequently changed, a smaller space will suffice than if the air becomes stagnant. The minimum size of a classroom is 18 feet by 15 feet, but if the desks are arranged parallel to the longer side of the room the width should not be less than 16 feet. As a window is not effective for a greater distance than 24 feet, that imposes another limit to the size of a room. Moreover, it is generally held that a person of normal vision cannot read ordinary writing on a blackboard at a greater distance than 30 feet, hence the length of a room must not exceed 30 feet if the blackboard is attached to the wall. The room should not be less than 12 feet high, but need not be more than 14 feet.

There should be separate entrances for each department and each sex, and the entrances should never be through cloak-rooms, nor should corridors be used for hanging clothes.

The entrance doors should follow the rule for doors of theatres and other public buildings, and open outwards. This is essential in case of fire or panic. The staircases must be fireproof and external to the halls, corridors, and classrooms, and there should always be a landing between the threshold of the door and the top stair of a flight leading from it; and the stairs should not go straight down from the door, as there is a danger of children coming out with a rush and falling down the whole flight, which is avoided if they have to turn to the right or left. The cloak-rooms should be well lighted and ventilated, and a separate numbered peg provided for each child. Apart from the sanitary advantage arising from each child always using the same peg, the arrangement conduces to order and speed in putting away clothes and getting them again on leaving school. Good ventilation in the cloak-rooms is especially necessary in damp weather.

The sanitary arrangements form a very important item in a block of school buildings. Wherever possible, earth-closets should be employed; they are the safest, most economical, and simplest of all the arrangements adopted. Unfortunately, the labour of removing the soil and supplying fresh earth precludes their use in towns, and recourse is had to water-borne sewage systems. The automatic flushing-tank system is about the best of the water systems; but, whatever system is adopted, it requires the constant care of the schoolkeeper, and the head-master must exercise due supervision to make sure that the work is carried out regularly.

English History.

The following questions from last year's History paper will suggest points that should be studied and which are not always dealt with in the ordinary text-book:—

1. What causes led to the prosperity of this country before the outbreak of the great French war, and to the distress which followed it? Mention any popular outbreaks at that time, and their immediate causes.

2. What were the Corn Laws, and their origin? Give some account of the agitation against them and their repeal.

3. Give a brief summary of four great European wars in the latter half of the nineteenth century, and show the result of each upon the political map of Europe.

4. When and under what circumstances did we acquire the following: Bombay, Jamaica, Nova Scotia, Cape Colony, Malta?

5. Give a sketch of the history of Egypt and the Soudan, from the dissolution of the dual control in 1882 to the present time.

6. Describe briefly the chief events of the two Afghan wars,

and show why Afghanistan is assuming an increasing importance in our eyes.

7. If you were studying English history from the accession of Charles I. to the death of Queen Anne, from what contemporary works could you gain information, and what works of fiction might you read as illustrative of that period? State clearly the nature of the information or illustration which you can get from each.

8. Give a sketch of the events connected with any two buildings or places of historical interest in London or its vicinity, which you would give to a party of older children who visited them.

9. On what occasions since 1793 have we been engaged in hostilities against, and in alliance with, France, Russia, and Spain?

10. In what parts of Asia and Africa have we European neighbours? Mention any difficulties which have arisen with any of them during the past century.

Geography.

Finish in detail the geography of the United States.

A glance at a map coloured to indicate elevation shows that the 95th meridian practically divides the States into two parts—the western half being almost entirely over 1000 feet above sea-level, the eastern half being below that altitude. The few western parts below 1000 feet are consequently of much greater relative importance; they include parts round Puget Sound, the narrow valley of the lower Columbia river, and the basins of the Sacramento and San Joaquin. In the western part, moreover, the obstacles to communication are very great. The rivers are not as a rule very useful for communication, as owing to the formation of the land and the extremely small rainfall they run through deep channels—the cañons of the Colorado being especially noted. The district is, however, crossed by four great railways: (1) the Northern Pacific, which runs from Minneapolis and follows the course of the Yellowstone River; (2) the Union Pacific, which passes from Chicago to Omaha, whence it runs by the valley of the Platte River, past the north of Great Salt Lake and reaches San Francisco; (3) the St. Louis and San Francisco Railway runs by the valleys of the Kansas and Arkansas Rivers, between the two towns from which it is named; and (4) the Southern Pacific runs from New Orleans to San Francisco and other Californian coast towns. The last is considered a masterpiece of railway engineering. All these railways cross the region of the Rocky Mountains at a great height, over 1200 miles of the second and third of these lines are above 4000 feet.

In the eastern part of the States communication is much easier. The rivers have a gentle current, and there are some important canals, such as the Erie Canal, which connects the great lakes with the River Hudson.

The climate of the United States resembles that of corresponding parts of the Old World, but, generally speaking, the rainfall is much less; there is nothing to correspond to the monsoons of Southern Asia, and in the western states there are frequent droughts in the summer months.

Farming operations are conducted on a very extensive scale. Land is cheap, and so there is not much necessity to secure a heavy yield per acre. This leads to exhaustive farming; new land is worked for corn until it will no longer yield a profitable crop, and then fresh prairie are broken up. In this way the corn-growing district is continually pushing its way further to the west. Cotton is grown in Georgia, Alabama, Mississippi, and Texas. Tobacco in many states, especially Virginia. Carolina rice used to be the best kind of rice in the world, but since the abolition of slavery its cultivation has gone out.

The mineral productions are extremely important. The United States now stands first among the coal-producing countries of the world. The chief coalfield is the Alleghany coalfield, which stretches from the middle of Alabama to the middle of Pennsylvania. The coal in this region is of good quality, consisting largely of anthracite. Coal is also found in the basin of the Missouri, but it is of more recent geological formation, and not so hard. In some parts of Pennsylvania and Ohio the ground yields large quantities of paraffin, which consists of a mixture of several bodies, which are represented by the chemical formula C_nH_{2n+2}. Of these the simpler members are gases at the ordinary temperatures, and form the so-called "natural gas," which is very largely used in some parts for manufacturing purposes. The higher members of the series are liquid at ordinary temperatures, and form the so-called paraffin oils, which are largely exported from the United States. But no matter how well supplied a country may be with coal the stock is bound to be sooner or later exhausted, then it must fall back on other sources of energy. The United States is fortunately well supplied with energy in the form of water-power, and this has been largely used in manufacturing industries. Sawmills are worked by primitive water-wheels. The falls of St. Anthony, on the upper Mississippi, work the immense flour-mills of Minneapolis, and several other towns, such as Rochester, owe their prosperity to the supply of energy by a fall of water. The introduction of electricity makes it possible to transform the energy and use it at a distance. The falls of Niagara alone represent an average of twelve million horse power.

The manufacture of iron and steel goods has increased recently by the discoveries of accessible iron and coal, particularly in Michigan, North Wisconsin, and Minnesota—chief towns, Marquette, Mesabi, Vermillion, and Menominee. At Pittsburg are immense iron and steel works, while Birmingham in Alabama threatens to rival its English namesake. The chief hardware products are agricultural implements, mining machinery, and railway material. The high prices charged for materials, owing to the protective tariffs, prevent the United States from doing much in the way of shipbuilding. The study of the position of the chief towns of the United States soon reveals the relation between their situation and their opportunities for trade and commerce.

Arithmetic.

Study the chapter on mensuration.

The following question was set last year: *The sides of a rectangular field are in the ratio of* 3 *to* 5, *and the area of the field is* $13\frac{1}{2}$ *acres. How long will it take to walk round the field at* 4 *miles an hour?*

If the short side is divided into 3 equal parts, and the long one into 5, and straight lines are drawn through the points of section parallel to the adjacent sides, the field will be divided into 15 equal squares. The area of each will be

$$13\tfrac{1}{2} \text{ ac.} \div 15, \text{ that is, } \frac{27}{30} \text{ ac. or } \frac{9}{10} \text{ ac.}$$

that is,

$$\frac{9 \times 4840}{10} \text{ sq. yds.} = 9 \times 484 \text{ sq. yds.}$$

$$\sqrt{9 \times 484} = \sqrt{3 \times 3 \times 22 \times 22} = 3 \times 22 = 66.$$

Therefore the long sides are 66×5 yds., and the short sides 66×3 yds., and the perimeter is 66×16 yds.

Time taken to walk 66×16 yds. at 4 miles an hour.

$$\frac{66 \times 16}{4 \times 1760} \text{ hrs.} = \frac{3}{20} \text{ hrs.} = 9 \text{ minutes.}$$

Another question, on the number of decimal places to be retained in the working, can be answered from a knowledge of the text-book, and the example attached to it shows the advantage to be secured by appropriate grouping of quantities: *Find to the nearest farthing the value of* 3·68772 *of* £1, 6s. $2\frac{1}{4}$d. + ·31228 *of* £1, 6s, $7\frac{1}{4}$d.

3·68772 of £1, 6s. $2\frac{1}{4}$d. + ·31228 of £1, 6s. $7\frac{1}{4}$d.

= 3·68772 of £1, 6s. $2\frac{1}{4}$ + ·31228 of £1, 6s. $2\frac{1}{4}$d. + ·31228 of 5d.

= 4 times £1, 6s. $2\frac{1}{4}$d. + ·31228 of 5d.

= £5, 4s. 9d. + 1·5614d. (or $1\frac{1}{2}$d.)

Ans. £5, 4s. $10\frac{1}{2}$d.

Algebra.

Study the chapter on Permutations and Combinations. Do not rely too much on formulæ, but endeavour to work, as far as possible, by reasoning from first principles.

Geometry

Practise the following constructions in as many different ways as possible, so as to be able to apply the principles in a variety of conditions: Construction of a segment of a circle containing an angle equal to a given angle. Division of straight lines into any number of equal parts, or into parts which are in any given proportion. Constructions of a fourth proportional to three given straight lines, and of a mean proportional to two

given straight lines. The construction of a third proportional is really the same in principle as the construction of a fourth proportion, but one line is used twice. Division of a straight line in extreme and mean ratio. Division of a straight line internally or externally, so that the rectangle contained by the parts shall be equal to a given square. Construction of regular polygons in and about circles.

Elementary Science.

Study the subject of Respiration.

We saw last month that the blood carries oxygen to the tissues and brings carbon dioxide from them. This exchange is called *internal respiration*. The process by which the blood takes up oxygen from the air and gives up carbon dioxide to it is called *external respiration*, and it is this which is most commonly referred to by the term respiration alone, although it should include both processes. Respiration can be best considered under two aspects—the mechanical and the chemical. The first seeks a complete answer to the question *How does the air get down into the lungs?* and the second deals with the question *What changes are produced?*

If the student considers for a moment the particles of air in his mouth at any instant, he will see that they will remain there indefinitely unless compelled to move by the action of a force. What is this force, and how is it set up? We may regard the lungs as a simple bag containing air, and if the pressure of the air in the lungs is the same as the pressure of the external air, then the particles of air in the mouth and nostrils, having the same pressure on both sides, will move in neither direction. If by any means, however, the lungs are expanded, then the pressure of the air in them is diminished, for by Boyle's law, which we explained in October, the pressure of a gas is inversely proportional to its volume. Then the particles of air in the mouth, having a less pressure from within than from without, will be driven inwards by the superior external pressure. On the other hand, when the cavity of the chest is diminished the pressure of the air in the lungs is increased, and the air in the mouth and nostrils is driven outwards by the increased internal pressure. We have next to see how the capacity of the lungs can be varied. This is brought about in two ways; first by the action of the diaphragm, and secondly by the movement of the ribs. A glance at the diagram of the chest shows the diaphragm arching upwards and forming the division between the thorax and abdomen. The diaphragm consists mainly of a muscular sheet, and when the muscle contracts the diaphragm is pulled down and made less arched. This increases the capacity of the chest. Again, if the student imagines a number of semicircles, such as pail-handles fastened to two upright sticks, he will see that the greatest space they can enclose will be the cylindrical space enclosed by them when they are all horizontal; if they are lowered the space is reduced. Now the ribs resemble such a machine as that; in their normal position they hang down somewhat, but on being raised somewhat, by the action of certain muscles—the *scaleni*, which fix the first rib and make it act as a starting-point, and the *external intercostal* muscles, which run from the first rib to the others and pull them outwards and upwards—they rise to a more horizontal position and so increase the capacity of the chest, which leads to inspiration. Expiration is brought about mainly by the elasticity of the lungs, which contract as soon as the above muscles cease to act. In fact, for quiet breathing no muscular effort is made in expiration; for forced expiration several muscles are brought into play, especially the muscles of the abdomen which, by causing a pressure on the abdominal viscera, force the diaphragm upwards. In different individuals different muscles play more or less important parts, which leads to the recognition of three distinct types of breathing; (1) the *Abdominal type*, observed in infants of both sexes up to the age of three, and in boys and men, and in the cat, horse and rabbit; (2) the *Costo-inferior* type, in which the lower ribs seem to rise, and the diaphragm is used as well; this is usual in the dog, and is sometime seen in boys and men; and (3) the *Costo-superior* type, in which the parts seen to move are the upper ribs; this is characteristic of women.

The lungs of different people differ in size, but on an average 330 c. inches may be taken as the quantity of air contained in the lungs of an adult man after the fullest possible inspiration. This is generally divided into four parts:—

(1) The Tidal or breathing air, about 20 c. in., which is the volume inspired and expired at each ordinary act of quiet respiration.

(2) Complemental air, about 110 c. in., which is the volume that can be taken in after an ordinary inspiration.

(3) Supplemental or reserve air, about 100 c. in., the volume that can be expelled after an ordinary expiration.

(4) Residual air, about 100 c. in., the volume of air which still remains in the lungs after as much as possible has been expired.

It follows that the greatest amount of air that can be expired after filling the lungs to the fullest extent consists of the sum of (1), (2) and (3) and is about 230 c. in. This is known as the *vital capacity*, and it is of great importance to develop this to the greatest possible extent.

The act of breathing carries fresh air only into the large air-pipes of the lungs, and it works its way into the small tubes and air-sacs by the process of diffusion.

Pure dry air contains practically 21 volumes of oxygen to 79 of nitrogen, the carbon dioxide amounts to only 4 parts in 10,000. The atmosphere is, however, never dry, but the amount of watery vapour in it varies very considerably. The air which is expired after an ordinary expiration contains rather more than 4 per cent. of carbon dioxide, and has its percentage of oxygen reduced to between 16 and 17 per cent. Students sometimes say that it contains no oxygen, the incorrectness of this is shown by making a red hot piece of charcoal glow brightly by blowing it. Expired air contains a great deal of watery vapour, as may be shown by breathing on a cold surface, and its temperature is also raised, and it contains organic particles which soon accumulate in the air and render it highly poisonous, and have more to do with the necessity for ventilating rooms than even the carbon dioxide itself.

A certain amount of respiration is carried on through the skin; but, owing to its dryness and thickness, the quantity of CO_2 discharged through the skin is only about one-fortieth of that discharged through the lungs. In animals whose skins are thin and wet the amount is very considerable; indeed, a frog has been known to live for forty days without lungs, respiration being carried on through the skin alone.

English Literature.

Read through the *Memoirs of Colonel Hutchinson*. This comes in the general reading section, and so an annotated edition will not be necessary. The student should make an analysis and notes as he goes on, and look out words in a dictionary, and follow movements, etc., on a map. Either Bell's edition or Macmillan's can be recommended.

French.

Extracts for translation :—

I.—*Bon sens du roi Henri.*

Du temps du bon roi Henri, le seul roi dont le peuple ait gardé la mémoire, des dons magnifiques furent offerts à son fils nouveau-né. On eut l'idée de faire contribuer toutes les communes de France en l'honneur du royal enfant. Les députés de La Rochelle apportèrent cent mille écus en or, somme énorme alors. Le roi leur dit: "Mes amis, c'est trop pour de la bouillie; gardez cela pour rebâtir chez vous ce que la guerre a détruit et n'écoutez jamais ceux qui vous parleront de me faire des présents." PAUL-LOUIS COURIER.

II.—*Une invasion de sauterelles.*

Un vent du Sud s'éleva et souffla toute la nuit, et lorsqu'au matin le jour parut, un immense nuage roux voilait le ciel d'un bout à l'autre; à travers ce brouillard fauve, le soleil semblait dépouillé de rayons.

Ce nuage différait des autres nuages, il était vivant, il bruissait et battait des ailes, et s'abattait sur la terre non en grosses gouttes de pluie, mais en bancs de sauterelles roses, jaunes et vertes, plus nombreuses que les grains de sable du désert; elles se succédaient par tourbillons, comme la paille que disperse l'orage; l'air en était obscurci, épaissi; elles comblaient les fossés, les ravines, les cours d'eau, éteignaient sous leurs masses les feux allumés pour les détruire; elles se heurtaient aux obstacles et s'y amoncelaient, puis les débordaient. Ouvrait-on la bouche, on en aspirait une; elles se logeaient dans les plis des vêtements, dans les cheveux, dans les narines; leurs épaisses colonnes faisaient rebrousser les chars: renversaient le passant isolé et le recouvraient bientôt; leur formidable armée s'avançait, occupant une largeur immense, fauchant l'herbe, réduisant les arbres à l'état de squelettes, dévorant les plantes jusqu'à la racine, et ne laissant derrière elle qu'une terre nue et battue comme une aire. THÉOPHILE GAUTIER.

OUR SCIENCE SECTION

☞ **Subscribers requiring Explanations of Difficulties in any branch of Science, or Advice upon Courses of Study, can obtain all help required by communicating with the Editor, and accompanying their query with the Coupon cut from this number.**

NOTES ON PHYSICS.

BY EDWIN EDSER, A.R.C.SC.

Author of "Heat for Advanced Students," "Light for Students," "Differential and Integral Calculus for Beginners," etc.

General Physics.

Show how the viscosity of a liquid can be calculated from its rate of flow through a narrow pipe.

London University, B.Sc. Pass, 1904 (External Students).

Viscosity is that property of a fluid which opposes the relative motion of its parts. The coefficient of viscosity of a fluid is measured as follows :—

Let the fluid be moving so that all parts of it do not possess the same velocity. Let A, B (Fig. 1) be elements of two imaginary planes, drawn in such a manner that all particles of the fluid in the plane A are moving with one uniform velocity parallel to that plane, while all particles in the parallel plane B are moving parallel to B with a smaller velocity. Above the plane A the velocity of the fluid is supposed to be greater than that between the planes A and B, and below B the velocity is supposed to be less than that between A and B. Let the velocities at points just above and just below A be measured, and let their difference be divided by the distance between the points in question ; then the result is called the *velocity gradient* at a point in the plane A. The velocity gradient for the plane B is obtained in a similar manner. Thus the velocity gradient may be defined as *the change of velocity per unit distance perpendicular to the direction of flow.*

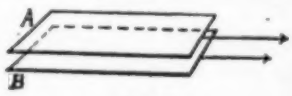


FIG. 1.

Experiment shows that the moving fluid immediately above A exerts a force, acting parallel to the direction of motion, on the fluid immediately beneath A ; its magnitude is proportional (1) to the area of A, and (2) to the velocity gradient at a point in the plane A. This force, of course, tends to accelerate the motion of the fluid between A and B, in the direction of the motion above the plane A. Since action and reaction are equal and opposite, an equal force is exerted on the fluid above A, tending to retard its motion. Similarly, the motion of the fluid just above B tends to accelerate the motion of the fluid just below B, and the corresponding reaction tends to retard the motion of the fluid just above B.

Let s be the area of the plane A, and let v' be the velocity gradient at a point in that plane ; then, since the tangential force f exerted by the fluid just above on that just below A is proportional to s and to v', we may write

$$f = ksv'$$

where k is a constant called the **coefficient of viscosity** of the fluid. Then

$$k = \frac{f}{sv'},$$

or the coefficient of viscosity of a fluid is the tangential force per unit area divided by the velocity gradient.

We can now find an expression for the *resultant force* exerted on the fluid between A and B. If v_a' represents the velocity gradient at a point in A, the area of A being s_a, the fluid above A exerts a force ks_av_a' on that between A and B. If v_b' and s_b represent the velocity gradient and the area of B, then the fluid just above B exerts a force ks_bv_b' on that just below B, and an equal but opposite reaction is exerted on the fluid above B. Thus the resultant retarding force acting on the fluid between A and B is equal to $k(v_b's_b - v_a's_a)$.

Experiment shows that the layer of fluid in contact with a fixed surface is stationary.

We are now in a position to apply the above reasoning to the flow of a liquid (*i.e.* an incompressible fluid) through a narrow tube. Let Fig. 2 represent the cross-section of a narrow tube, very much magnified. The liquid in contact with the walls of the tube will be stationary, and the velocity of the liquid will increase as we proceed inwards toward the axis of the tube. At the axis, the velocity of the liquid will have a maximum value ; at two points equidistant from the axis, and on opposite sides of it, the liquid will be moving with equal velocities. Let the points be very near to each other (*i.e.* at an infinitesimal distance from the axis) ; then since their velocities are equal, there is no change of velocity in passing from one point to the other, and therefore the velocity gradient is equal to zero at the axis of the tube. The conditions of flow are therefore these :—

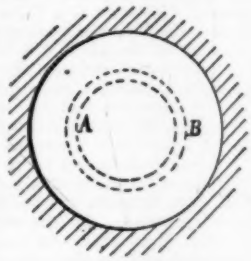


FIG. 2.

(1) At the surface of the tube the **velocity** of the liquid is equal to zero.

(2) At the axis of the tube the **velocity gradient** is equal to zero.

Let the length of the tube be l ; and let the pressure of the liquid where it enters the tube be p dynes per sq. cm. greater than where it leaves the tube. Draw the two circles A and B (Fig. 2) with a point on the axis of the tube as centre, and let r_b be the radius of the circle B, while r_a is the radius of the circle A. We may suppose these circles to represent the cross-sections of two imaginary cylinders co-axial with the tube. If the flow is steady, the liquid that enters one end of the tube between the two imaginary cylinders will flow along the tube without crossing the cylindrical surfaces. Since the velocity of the liquid as it flows along between these cylinders is constant, the external force urging it along its path must be equal to the resultant retarding force due to viscosity exerted on it. The area of the external cylindrical boundary is $2\pi r_bl$, while that of the inner cylinder is $2\pi r_al$; hence if v_b' is the velocity gradient at any point in the outer cylinder, while v_a' is the velocity gradient at any point in the inner cylinder, the resultant retarding force acting on the liquid between the cylinders is

$$k(v_b' \times 2\pi r_bl - v_a' \times 2\pi r_al) = 2\pi lk(v_b'r_b - v_a'r_a) \quad . \quad . \quad (1)$$

Since the uniform pressure acting over the end of the tube where the liquid enters is p dynes per sq. cm. greater than the pressure where the liquid leaves the tube, the effective external force acting on the liquid between the imaginary cylinders of radii r_b and r_a is equal to

$$p(\pi r_b^2 - \pi r_a^2) = \pi p(r_b^2 - r_a^2);$$

hence since this force must be equal to the retarding force given by (1), we have

$$2\pi lk(v_b'r_b - v_a'r_a) = \pi p(r_b^2 - r_a^2)$$

$$2lk(v_b'r_b - v_a'r_a) = p(r_b^2 - r_a^2) \quad . \quad . \quad . \quad (2)$$

Let us now suppose that the whole of the cross section of the tube is divided into circular strips by means of circles similar to the two drawn in Fig. 2, the radii of successive circles being r_0 (supposed to be infinitesimally small), r_1, r_2, r_3, . . . r_{n-1}, r_n.

Let the velocity gradients for these circles be v'_0, v'_1, v'_2, v'_3 . . . v'_{n-1}, v'_n. For each pair of neighbouring circular sections we may write down an equation similar to (2); doing this for the various sections, we obtain

$$2lk(v_1'r_1 - v_0'r_0) = p(r_1^2 - r_0^2)$$
$$2lk(v_2'r_2 - v_1'r_1) = p(r_2^2 - r_1^2)$$
$$2lk(v_3'r_3 - v_2'r_2) = p(r_3^2 - r_2^2)$$
$$\ldots\ldots\ldots = \ldots\ldots$$
$$\ldots\ldots\ldots = \ldots\ldots$$
$$2lk(v_n'r_n - v'_{n-1}r_{n-1}) = p(r_n^2 - r^2_{n-1}).$$

Adding these equations together, we obtain

$$2lk(v_n'r_n - v_0'r_0) = p(r_n^2 - r_0^2).$$

Also, since v_0' is the velocity gradient at an infinitesimal distance r_0 from the axis, $v_0' = 0$. Further, r_0^2 is negligibly small. Consequently we have

$$2lkv_n'r_n = pr_n^2$$

$$\therefore v_n' = \frac{p}{2lk}r_n \quad \ldots\ldots\ldots \quad (3)$$

which proves that *the velocity gradient is directly proportional to the distance r_n from the axis*, so that it will be greatest at the walls of the tube where the velocity is equal to zero.

Let v_0, v_1, v_2, v_3 . . . v_{n-1}, v_n be the velocities at the various circular sections; then the velocity gradient midway between the circles of radii r_0 and r_1 will be $(v_0 - v_1)/(r_1 - r_0)$, and the corresponding value of r will be $(r_1 + r_0)/2$. Since r_n and v_n' in (3) may refer to any circle, we may substitute in (3) the values just found. Then

$$\frac{v_0 - v_1}{r_1 - r_0} = \frac{p}{4lk}(r_1 + r_0)$$

$$\therefore v_0 - v_1 = \frac{p}{4lk}(r_1^2 - r_0^2).$$

Similarly

$$v_1 - v_2 = \frac{p}{4lk}(r_2^2 - r_1^2)$$

$$v_2 - v_3 = \frac{p}{4lk}(r_3 - r_2)$$

$$\ldots = \ldots\ldots$$

$$v_{n-1} - v_n = \frac{p}{4lk}(r_n - r_{n-1}).$$

Adding these equations together, we obtain

$$v_0 - v_n = \frac{p}{4lk}(r_n^2 - r_0^2)$$

$$= \frac{p}{4lk}(r_n^2) \quad \ldots\ldots\ldots \quad (4)$$

since r_0^2 is negligibly small. If we now suppose r_n to be equal to the internal radius a of the tube, we have $v_n = 0$.

$$\therefore v_0 = \frac{p}{4lk}a^2 \quad \ldots\ldots\ldots \quad (5)$$

which gives the velocity of the liquid along the axis of the tube. To find the velocity at a point not on the axis of the tube, let this point be at a distance r_n from the axis; then substituting the value of v_0 from (5) in (4), we have

$$v_n = v_0 - \frac{p}{4lk}r_n^2$$

$$= \frac{p}{4lk}(a^2 - r_n^2) \quad \ldots\ldots\ldots \quad (6)$$

Equation (6) gives the relation between the velocity v_n and the distance r_n from the axis of the tube. In order to determine k practically, it is necessary to find an expression for the quantity of liquid which flows through the tube in a given time, say, in one second.

Now the velocity at a distance r_n from the axis may, for purposes of calculation, be supposed to consist of two components in opposite directions; the first, equal to $pa^2/4lk$, is constant for all positions in the tube, while the second or reverse component, equal to $(-pr_n^2/4lk)$, varies directly as the square of the distance from the axis. We may therefore suppose that the flow is made up of a uniform *direct component*, which will deliver $\pi a^2 \times (pa^2/4lk) = p\pi a^4/4lk$ cubic centimetres per second, together with a *reverse component* varying as the square of the distance from the axis. The reverse flow is equal to zero at the axis, and is equal to the rate of direct flow at the walls of the tube. The quantity of liquid carried by the reverse flow between two cylinders of radii r_a and r_b (Fig. 2) will be

$$\pi(r_b^2 - r_a^2) \times \frac{p}{4lk} \times \left(\frac{r_b^2 + r_a^2}{2}\right) = \frac{p\pi}{8lk}(r_b^4 - r_a^4),$$

where $(r_b^2 + r_a^2)/2$ is used to give the average value of r^2 between the cylinders. Writing down the expressions for the flow between the various cylinders of radii r_0, r_1, r_2, . . . &c., and adding these together, we find that the total quantity of fluid carried by the reverse flow within the cylinder of radius r_n is equal to

$$\frac{p\pi}{8lk}(r_n^4 - r_0^4).$$

Substituting $r_n = a$, the internal radius of the tube, and $r_0 = 0$, we find that the total quantity of liquid carried by the reverse flow through the tube is

$$\frac{p\pi}{8lk}a^4,$$

and subtracting this from the quantity of liquid delivered per second by the direct flow, we find that the quantity of liquid Q which actually enters or leaves the tube in a second is given by the equation

$$Q = \frac{p\pi a^4}{8lk}.$$

Thus if the difference p between the pressures at which the liquid enters and leaves the tube is observed, and the volume Q of the liquid which leaves the tube is measured, the internal radius a and the length l of the tube being known, the value of k can be calculated in terms of these quantities.

Those students who are acquainted with the calculus should have no difficulty in proving that

$$Q = \frac{2\pi p}{4lk}\int_0^a (a^2 - r^2)\, r\, dr$$

$$= \frac{\pi p}{2lk}\left[\frac{a^2r^2}{2} - \frac{r^4}{4}\right]_0^a = \frac{\pi p}{8lk}a^4.$$

Hence the quantity of liquid delivered per second varies inversely as the coefficient of viscosity k, and directly as the fourth power of the radius a of the tube. This result was obtained by Poiseulle for the flow of a liquid through a narrow tube; it does not hold for large tubes unless the velocity is less than a certain critical value, as otherwise the flow of the liquid through the tube is not steady.

Heat.

If a plate of iron, one foot square and one inch thick, is capable of transmitting 7·5 British thermal units (pound-degree Fahr.) per minute, when the difference between the temperatures of its opposite faces is 1° F., find the conductivity on the centigrade system in C. G. S. units.

1 lb. = 453·6 grams.
1 in. = 2·54 cms.

Board of Education, Heat (Advanced), 1903.

The conductivity is the heat transmitted per second through unit area, divided by the temperature gradient (change of temperature per unit distance normal to the surface).

1 B. Th. U. = heat absorbed by 1 lb. of water when its temperature rises 1° F.

1 B. Th. U. = heat absorbed by 453·6 grams of water when its temperature rises $\frac{5}{9}$° C.

1 B. Th. U. $= \frac{453{\cdot}6 \times 5}{9}$ gram calories.

" " = 252 gram. calories.

1 square foot = $(12 \times 2{\cdot}54)^2$ sq. cms. $\doteq$ 928 sq. cms. (nearly).

$\therefore$ heat transmitted per second per sq. cm. $= \frac{7{\cdot}5 \times 252}{60 \times 928} = 0{\cdot}035$.

Temperature gradient $= \frac{5}{9}$° C. $\div 2{\cdot}54 = 0{\cdot}141$ deg. C. per cm.

$\therefore$ Conductivity $= \frac{0{\cdot}035}{0{\cdot}141} = 0{\cdot}249$.

A projectile weighing 100 lbs. strikes a target when moving at 2000 ft. per second. Find the heat generated if the mechanical equivalent of the British thermal unit is 774 ft.-lbs., and the acceleration of gravity is 32·2 ft. per second per second.

Board of Education, Heat (Advanced), 1903.

Kinetic energy of projectile $= \frac{1}{2}mv^2$.

$= 50 \times (2000)^2 = 2 \times 10^8$ ft.-poundals.

$= \frac{2}{32 \cdot 2} \times 10^8$ ft.-lbs.

$\therefore$ Heat generated $= \frac{2 \times 10^8}{32 \cdot 2 \times 774} = 8000$ B. Th. U.

Electricity and Magnetism.

Define magnetic force H and magnetic induction B. Show that the energy per unit volume of the magnetic field between two plane poles is given by $BH/8\pi$.

London University, B.Sc. Pass, 1905 (*External Students*).

The force exerted by one point pole on another is directly proportional to the product of the strengths of the poles, and inversely proportional to the square of the distance between them. The force also varies with the nature of the surrounding medium, so that we may write

$$f = \frac{m_1 m_2}{\mu r^2},$$

where f is the force (in dynes) exerted by a point pole of strength m_1 on another of strength m_2 placed at a distance r apart. μ is a constant depending on the nature of the medium, called the permeability of the medium. μ is equal to unity for a vacuum, and approximately equal to unity for air; for paramagnetic media μ is greater than unity, while for diamagnetic media μ is less than unity.

Using Faraday's conception of lines of force, a magnet pole merely consists of the ends of a certain number of lines of force, this number being proportional to the pole strength. Let a pole of strength m consist of the ends of n lines of force, radiating uniformly from it; then if an imaginary sphere of radius r be drawn around the pole as centre, the n lines of force will pass normally through the surface of this sphere, and

$$\frac{n}{4\pi r^2} \quad \ldots\ldots\ldots \quad (1)$$

lines will pass through each sq. cm. of the surface of the sphere. Let us suppose that a unit N pole is placed anywhere on this imaginary spherical surface; then if the surrounding medium is air ($\mu = 1$), the force exerted by the pole of strength m on the unit pole will be equal to

$$\frac{m \times 1}{r^2} = \frac{m}{r^2} \quad \ldots\ldots\ldots \quad (2)$$

Both (1) and (2) contain r^2 in the denominator, and by definition n is proportional to m; hence we may choose n so that the number of lines of force per sq. cm. given by (1) is *equal* to the force exerted on a unit pole in air or a vacuum, given by (2); then

$$\frac{n}{4\pi r^2} = \frac{m}{r^2}$$

$$n = 4\pi m.$$

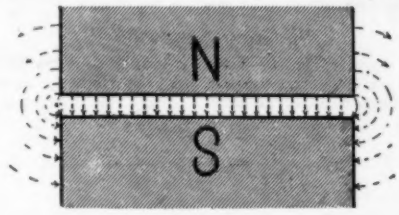
Hence if a pole of strength m consists of the ends of $4\pi m$ lines of force, the force (in dynes) exerted on a unit N pole when placed in air in the neighbourhood of the pole of strength m, will be equal to the number of lines of force per sq. cm. at the point where the unit pole is placed. This result only holds so long as the surrounding medium is air ($\mu = 1$); if the surrounding medium has a permeability μ differing from unity, then the force acting on a unit N pole would have only $1/\mu$ of the value of the force produced if the surrounding medium were air. The number of lines of force n leaving the pole is independent of the surrounding medium, since in all circumstances the pole consists of the ends of n lines of force. Consequently the number of lines of force passing through a square centimeter at a distance r from the pole is independent of the medium. *Hence when a unit N pole is placed in a medium of permeability μ, the force acting on it is equal to the number of lines of force per square centimetre divided by the permeability of the surrounding medium.*

The force in dynes that would act on a unit N pole if it were placed at any given point is called the **magnetic force** at that point; this is generally denoted by H.

The number of lines of force passing normally through 1 sq. cm. at any place is called the **magnetic induction** at that place; this is generally denoted by B. When the surrounding medium is air, B = H. When the surrounding medium has a permeability μ, then

$$H = \frac{B}{\mu}$$

When two equal but opposite plane magnet poles are placed parallel and near to each other, the lines of force stretching between them are mostly straight and parallel, extending normally from one polar surface to the other (Fig. 3). The number of lines of force which bulge out sideways, near the edges of the



(FIG. 3.)

poles, will be small in comparison with the number that extend straight across, when the width of either pole is very large in comparison with the distance between the two. The force exerted on a unit pole placed between the two pole surfaces is constant, since the number of lines of force per sq. cm. is constant. Let either pole have a strength m, its area being a; then $4\pi m$ lines of force leave the N pole and extend straight across to the S pole (neglecting the few lines which bulge out sideways near the pole edges), and $4\pi m/a$ lines of force leave each square centimetre of the N pole, and proceed parallel to each other till they enter the S pole. Hence *anywhere between the poles the number of lines of force per sq. cm.* (*i.e.* B) *is equal to* $4\pi m/a$, and the force exerted on a unit N pole by the two opposite poles is therefore equal to $4\pi m/a\mu$. Notice that this force is independent of the distance between the poles; this is due to the fact that the lines of force between the flat poles do not diverge as they would in leaving a small N pole. The pole S will be attracted toward N with a force equal to the field *due to* N, multiplied by the pole strength of S. Now a unit N pole placed between the flat pole surfaces is acted upon by a uniform force $4\pi m/a\mu$, due to both the poles; this force is made up of a repulsion from the flat pole N and an equal attraction toward the flat pole S; hence either pole exerts a force $4\pi m/2a\mu$ on a unit pole placed near it. The attraction of the flat pole N on the flat pole S is equal to the force exerted by N on a unit pole placed near it (*i.e.* $4\pi m/2a\mu$) multiplied by the pole strength of the flat pole S which is numerically equal to m. Hence attraction exerted by N on S $= 4\pi m^2/2a\mu$.

But if B = no. of lines of force per sq. cm. between the poles,

$$B = 4\pi m/a$$

$$\therefore m = \frac{Ba}{4\pi},$$

and attraction exerted by N on S $= \frac{4\pi m^2}{2a\mu} = \frac{4\pi}{2a\mu} \cdot \left(\frac{Ba}{4\pi}\right)^2$

$$= \frac{B^2 a}{8\pi\mu}.$$

To find the energy stored in the space between the poles, we must determine the work done while one pole is allowed to approach the other till the two meet. Let d be the distance between the poles; then as one pole approaches the other, it is acted upon by a uniform force $B^2a/8\pi\mu$, and as this force acts through a distance d, the work done is

$$\frac{B^2 ad}{8\pi\mu}.$$

This gives the total energy stored between the poles, *i.e.* in the volume ad. Hence the energy per unit volume

$$= \frac{B^2}{8\pi\mu} = \frac{BH}{8\pi},$$

since $B/\mu = H$. It must be remembered that μ is the permeability, *not* of the iron or steel of the magnets, but of the medium filling the spaces between the poles.

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July 1906.
December 1907.

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FIRST CLASS

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1903	**99**
1904	**110**
1905	**196**
Total	**405**

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MATHEMATICS.

(STAGES 2 AND 3.)

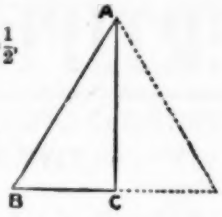
BY FRANK CASTLE, M.I.M.E.,

Royal College of Science; Lecturer on Mathematics, etc., Morley College; Author of "Elementary Practical Physics," "Practical Mathematics," etc.

Trigonometrical Ratios.—The numerical values of the ratios sine, cosine, and tangent for 30°, 45°, and 60° should be committed to memory; this may be easily effected as follows:—

Draw an equilateral triangle, each side of 2 units length. Then each angle is 60°. ACB represents one-half of such a triangle, the perpendicular AC being $\sqrt{2^2-1}=\sqrt{3}$.

The angle at B is 60°, at A is 30°.



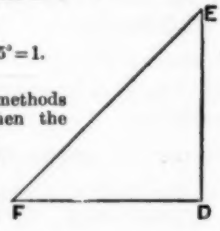
$$\sin 60^\circ=\frac{AC}{AB}=\frac{\sqrt{3}}{2},\qquad \cos 60^\circ=\frac{BC}{AB}=\frac{1}{2},$$

$$\tan 60^\circ=\frac{AC}{BC}=\sqrt{3}.$$

$$\sin 30^\circ=\frac{BC}{AB}=\frac{1}{2},\qquad \cos 30^\circ=\frac{\sqrt{3}}{2},$$

$$\tan 30^\circ=\frac{1}{\sqrt{3}}.$$

For angles of 45°.—Draw a right-angled isosceles triangle EDF. Then if each of the equal sides is 1 unit length, the hypotenuse $FE=\sqrt{2}$.



$$\therefore\quad \sin 45^\circ=\frac{1}{\sqrt{2}}=\cos 45^\circ,\qquad \tan 45^\circ=1.$$

To construct a given angle.—The methods adopted to construct an angle, when the magnitude of one of its trigonometrical ratios is given, may be seen from the following examples:—

Ex. 1. Construct the angle whose tangent is $\sqrt{3}$, find the sine and cosine of the angle.

Set off BC a horizontal line of unit length, and at C draw CA perpendicular to CB, making $CA=\sqrt{3}$; join A to C, then ABC is the angle required.

As $BC=1$, $AC=\sqrt{3}$.

$$\therefore\ AB=\sqrt{1+3}=2.$$

$$\text{Hence } \sin(ABC)=\frac{\sqrt{3}}{2},\ \cos(ABC)=\frac{1}{2}.$$

Ex. 2. (*a*) Show how to construct an angle whose tangent is 1·5, and calculate the numerical values of the sine and cosine of that angle (N.B. $\sqrt{13}=3{\cdot}606$).

(*b*) Find the sine and cosine of angles of 30° and 45°. (1900)

As in the preceding example, make the base BC of the right-angled triangle 1 unit in length and the perpendicular $CA=1{\cdot}5$; join A to B, then ABC is the angle required.

$$AC=\sqrt{1+\frac{9}{4}}=\frac{\sqrt{13}}{2};$$

$$\therefore\ \sin ABC=\frac{3}{2}\div\frac{\sqrt{13}}{2}=\frac{3}{\sqrt{13}}=\frac{3\sqrt{13}}{13}=0{\cdot}832.$$

$$\cos ABC=\frac{2}{\sqrt{13}}=\frac{2\sqrt{13}}{13}=0{\cdot}5546.$$

Logarithms of the trigonometrical ratios.—As the numerical values of the sine and cosine of an angle cannot exceed unity, it follows that the logarithms of either of these ratios must be such that the mantissa of the logarithm is a decimal fraction and the characteristic zero or a negative number. Thus as $\sin 30^\circ=\frac{1}{2}$.

$$\therefore\ \log\sin 30^\circ=\log\tfrac{1}{2}=\log 1-\log 2$$
$$=\bar{1}{\cdot}6989700\ .\ .\ .\ .\ .\ .\ (\text{i.})$$

It is found to be convenient to write this in the form—

$$\text{L}\sin 30^\circ=9{\cdot}6989700$$

in which 10 is added to (i.) and is then called the *tabular logarithm* of sin 30°, this is written as L sin 30°.

$$\therefore\ \text{L}\sin 30^\circ=\log\sin 30^\circ+10=9{\cdot}6989700.$$

The tabular logarithm is usually used in the solutions of triangles, etc.

Ex. 3. Find the common logarithm of $(\tan 34^\circ 47')^{\frac{1}{3}}$. (1905)

$$\text{L}\tan 34^\circ 47'=9{\cdot}8417265;$$
$$\therefore\ \log\tan 34^\circ 47'=\bar{1}{\cdot}8417265.$$
$$\log(\tan 34^\circ 47')^{\frac{1}{3}}=\tfrac{1}{3}(\bar{1}{\cdot}8417265)$$
$$=\bar{1}{\cdot}9683453.$$

Ex. 4. Find the numerical value of $(\tan 35^\circ 40')^3$. (1903)

$$\log\tan 35^\circ 40'=\bar{1}{\cdot}8559376$$
$$\log(\tan 35^\circ 40')^3=3\times\bar{1}{\cdot}8559376$$
$$=\bar{1}{\cdot}5678128$$
$$8025$$
$$103$$

$$\log 36967=5678142$$
$$\text{"}\quad 66=\quad 8025$$
$$\text{Diff.}\quad 117$$

$$\therefore\ \text{proportional part is } \frac{103}{117}=88;$$

$$\therefore\ (\tan 35^\circ 40')^3=0{\cdot}3696688.$$

Ex. 5. Find the true value of the logarithm of the tangent of 13° 12′ 45″ from the logarithms given in the table; find also the numerical value of the cube root of tan 13° 12′ 45″. (1902)

$$\text{L}\tan 13^\circ 13'=9{\cdot}3707994$$
$$12'=\quad 2315$$

$$\text{Diff. for } 60''=5679$$

$$\text{Diff. for } 45''=\frac{45}{60}\times 5679=4259;$$

$$\therefore\ \text{L}\tan 13^\circ 12' 45''=9{\cdot}3706574$$
$$\log 13^\circ 12' 45''=\bar{1}{\cdot}3706574$$
$$\log\sqrt[3]{(13^\circ 12' 45'')}=\bar{1}{\cdot}7902191$$
$$\therefore\ \sqrt[3]{(13^\circ 12' 45'')}=0{\cdot}6169061.$$

Ex. 6. Find from a diagram the numerical value of the sine and tangent of 60°. Find from your answer the tabular logarithm of the sine of 60°. (1903)

Ex. 7. If ABC is a triangle having a right angle at C, and such that $a=3$ and $c=7$ units, write down the numerical value of the sine of A, thence find the true logarithm of sine A, the tabular logarithm, and the number of degrees with the odd minutes and seconds in the angle A. (1904)

Ex. 8. Show how to construct an angle whose cosine is 0·6, and write down the numerical value of the sine and tangent of that angle. (1900)

Ex. 9. Find the numerical values of $(\tan 29^\circ 45')^3$.

How is it known, before the calculation is made, that the result should come out a little less than $\frac{1}{3}$? (1904)

Ans. 0·3266660.

Ex. 10. Find the logarithm of the sine of 30°, and write down its logarithm as it is entered in a table of logarithms of sines. Explain why a difference is made between the true and the tabular logarithm. (1902)

Ex. 11. Find the logarithm of tan 42° 30′ 45″, $\tan(42^\circ 30' 45'')^{\frac{1}{3}}$. (1900)

Given
$$\text{L}\tan 42^\circ 30'=9{\cdot}9620525$$
$$\text{"}\quad 31'=\quad 3061$$

Ans. $\bar{1}{\cdot}9811213$.

Ex. 12. (*a*) Show that the logarithm of the product of two numbers equals the sum of the logarithms of the numbers.

(*b*) Find the logarithm (with a positive mantissa) of $(0{\cdot}0056)^{\frac{1}{3}}$ and of $(\sin 37^\circ 35' 40'')^{\frac{1}{3}}$.

(*c*) Find the numerical value of $0{\cdot}81\div\sqrt{112}$. (1900)

Ex. 13. Find without using tables the value of x for which $\log x=3\log 18-4\log 12$.

Find the numerical values of $\sqrt[5]{\frac{7}{60}}$, $\sqrt{(\sin 36^\circ 51')}$. (1901)

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Calcium Sulphate in Ammonium Sulphate Solution.—Determinations of the solubility of calcium sulphate in water and in solutions of ammonium sulphate at 25° have given the following results. The solubility in water is 0·2083 gram per 100 cc. On the first addition of ammonium sulphate to the aqueous solution, a notable decrease in the solubility of the calcium sulphate is observed. As the concentration of the ammonium sulphate increases, the fall becomes more gradual, and the solubility passes through a minimum equal to about two-thirds of its original value when the concentration is about 0·09 molecules per litre. From this point the solubility gradually increases until the concentration of the ammonium sulphate is 0·6 molecules per litre, when the solubility of the calcium sulphate has the same value as in pure water.

With three molecules of ammonium sulphate per litre, the solubility of calcium sulphate is twice as great as in water.

The specific conductivity of concentrated ammonium sulphate solutions is decreased by saturation with calcium sulphate.

On the assumption that ammonium sulphate is dissociated into 2 NH'_4 and SO''_4, and calcium sulphate into $Ca^{\cdot}$ and SO_4'', and that the conductivity is a measure of such dissociation, the solubility of calcium sulphate in dilute ammonium sulphate is greater than that required by the mass law.

Liquid Hydrogen Sulphide.—The characters exhibited by liquid hydrogen sulphide differ widely from those of the gas. When quite pure the liquid can be kept in Dewar's vacuum vessels. Isolated from external moisture it undergoes slow evaporation, which is accelerated by the addition of pieces of pumice, etc. It has a neutral reaction to litmus paper, owing either to the non-dissociation of the hydrogen sulphide or to the inactivity of the litmus at the low temperature of the liquid. Electrically, liquefied hydrogen sulphide acts as an insulator, and in the neighbourhood of its boiling-point it does not exhibit in its chemical behaviour that analogy with water which would be expected from its chemical composition. As a solvent it behaves to some extent similarly to carbon disulphide, alcohol, ether, or benzene; but although its solvent powers are relatively extended, its ability to cause dissociation is far less marked than that of water and other strongly dissociating solvents. The salts of energetic bases are not soluble in it, but non-metallic compounds are dissolved by it, giving conducting solutions.

Iodine, when dissolved in liquid hydrogen sulphide, bestows on it very considerable conductivity. Phosphorus iodide has the same effect to a less degree, and the haloid compounds of the other non-metals, although they dissolve in very small proportions, give solutions of moderate conductivity. Solutions of certain organic substances, for example, iodoform and tetramethylammonium iodide, yield solutions having conductivities which indicate that organic compounds may become ionised in liquid hydrogen sulphide.

The nitro-derivatives of benzene, nitronaphthalene, and naphthylamine dissolve moderately well in this solvent, but the solutions are non-conducting. There is a marked difference between the solubility of picric acid and that of potassium picrate.

Most of the above-mentioned compounds dissolve in liquid hydrogen sulphide with absorption of heat, but exceptions to this rule are met with in phosphorus trichloride and tribromide.

Hydrocarbons, alcohols, ethers, etc., also dissolve in liquid hydrogen sulphide.

The marked chemical activity of hydrogen sulphide in the state of gas or in aqueous solution vanishes almost entirely when the gas is liquefied. Thus, iodine reacts but very slightly with liquid hydrogen sulphide, but gives a dark red solution; also, liquid sulphur dioxide and liquid hydrogen sulphide mix, but only react readily in presence of an ionising liquid. Salts of copper, lead, etc., are unchanged by liquid hydrogen sulphide, and the same is the case with powerful oxidising agents such as chromium trioxide, chromates, dichromates, permanganates, etc. Concentrated sulphuric acid and Nordhausen acid are both solidified in liquid hydrogen sulphide, but do not react with it.

Sodium and potassium remain unchanged in the liquid, and mercury solidifies in it without exhibiting any superficial alteration. Bromine, even in the solid condition, reacts energetically with liquid hydrogen sulphide, forming sulphur bromide.

Iodine and liquid hydrogen sulphide do not react when dissolved in ordinary solvents, such as the lower aliphatic hydrocarbons, carbon disulphide, or chloroform.

Nor does the presence of thiophen determine any reaction, but decane, carvene, amylene, and benzene do so, various products being obtained. More marked in their power to cause interaction between iodine and liquid hydrogen sulphide are hydroxylated compounds, and the same is the case with aldehydes and ketones; indeed, benzaldehyde alone reacts with the liquid sulphide.

Luminescence of Crystals in the Cathode Rays.—Every mineral capable of becoming luminous under the influence of the cathode rays emits light of a characteristic colour, which, for minerals belonging to the same group, is independent of the natural colour of the crystal. In some minerals, for example calcite and apatite, the colour of the cathode luminescence is identical with that of the fluorescence excited in it by ordinary light; in others, for instance, phosgenite and cerussite, it is similar; whilst in aragonite and certain others it is totally different. The duration of this luminescence after the cathode rays have ceased to act varies in different minerals, and is marked in calcite and orthoclase.

The excitation of cathode luminescence is not equally easy with all minerals, and takes place very readily with scheelite, apatite, and anatase. The luminescence is not completely polarised in any of the minerals, and with some, for example, anglesite and calcite, it exhibits no trace of polarisation.

Inclination of the face to the cathodic pencil does not alter the qualitative relations of the phenomenon.

The orientation of the plane of polarisation is not the same in crystals of the tetragonal and hexagonal systems.

Luminescence of Potassium Sulphate.—It has been observed when potassium and sodium sulphates are fused together in molecular proportion, the product dissolved in water and left to crystallise, the separation of the potassium sulphate crystals is accompanied by the emission of flashes of light. If the hot solution of the fused sulphates is allowed to crystallise without being disturbed by external influences there is no emission of light, but flashes of light are at once observed if a crystal is touched with a piece of iron, silver, or platinum. The phenomenon appears, therefore, to be due to the disintegration of crystals already formed, and this disintegration can be readily brought about by the agitation of the containing vessels. The admixed sodium sulphate can be replaced by other substances without interfering with the phenomenon, and it has been finally shown that crystals of potassium sulphate separating from pure aqueous solution also exhibit luminescence when disturbed.

Strontium - Ammonium.—By the action of pure dry ammonia on strontium at −60°, reddish-brown crystals of strontium-ammonium are formed, which dissolve in excess of ammonia to a deep blue solution.

Analysis of the crystals which remain when the ammonia solution is evaporated at different temperatures gave Sr, 6·38 NH_3 at −60°, Sr, 6·15 NH_3 at −23°, and Sr, 6·01NH_3 at 0°.

The probable formula is Sr, $6NH_3$, analogous to that of the barium compound.

Volumetric Estimation of Red Lead.—The methods of estimating red lead volumetrically given below will be of interest to analytical students:—

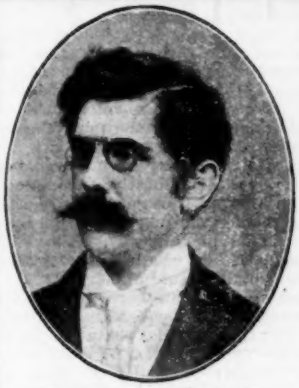
1*st Method.*—2·064 grams of the sample are heated with 50 c.c. of nitric acid of sp. gr. 1·2, 50 c.c. of N/5 solution of oxalic acid are added, and when the lead peroxide has disappeared, the liquid is partly neutralised with barium hydroxide. Solution of sodium sulphate is now added to precipitate the lead and barium, and after adding some dilute sulphuric acid to decompose any barium oxalate, the excess of oxalic acid is titrated with N/5 permanganate. One c.c. of oxalic acid decomposed by the lead peroxide represents 3·3 per cent. of red lead.

The matter may be simplified by treating the sample with 50 c.c. of nitric acid of sp. gr. 1·3, and adding the oxalic acid from a burette until the last trace of lead peroxide has disappeared.

2*nd Method.*—3·415 grams of the sample are heated with hydrochloric acid, the chlorine evolved is passed through a solution of potassium iodide, and the liberated iodine is titrated with N/10 sodium thiosulphate; each c.c. represents 1 per cent. of red lead.

3*rd Method.*—1·032 gram of the sample is heated with 20 c.c. of N/5 nitric acid and 20 c.c. of neutral hydrogen peroxide in a retort, the drawn-out neck of which dips into N soda, which should not be in excess.

When the lead peroxide is decomposed, the flame is removed,



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and the soda solution allowed to enter the retort. Excess of sodium sulphate is added, then phenolphthalein, and the free nitric acid titrated with normal soda. Ten times 100 (representing 20 c.c. of N/5 nitric acid) – number of c.c. of soda required for neutralisation, gives the percentage of total lead in the sample.

If only the lead peroxide is to be estimated, the sample is first treated with dilute nitric acid, and the undissolved matter is collected on a filter, or the decomposed mixture is carefully poured on to a saturated solution of sodium and potassium nitrates, contained in a conical vessel, when the lead peroxide sinks to the bottom, and the acid liquid may be siphoned off. The deposit is then treated with hydrogen peroxide as directed.

Estimation of Thallium.—Soluble thallous salts are oxidised to the thallic condition by auric bromide (bromoauric acid, $HAuBr_4$); an equivalent amount of gold being precipitated, the latter is collected and weighed. The amount of thallium present is obtained by multiplying the weight of this precipitate by the factor 1·5533.

The quantity of thallous compound taken for analysis should correspond with 0·2 – 0·3 gram of the pure chloride.

The auric bromide is conveniently prepared by dissolving gold in a mixture of bromine and hydrobromic acid, and evaporating the solution to the crystallising point.

PHYSIOGRAPHY.

(STAGES 2 AND 3.)

HYGROMETRY—(*continued*).

THE hygrometers used for the direct determination of the dew-point depend for their action upon the condensation of moisture on a smooth surface cooled by artificial means.

One of the earlier forms of hygrometer, and the one that has, perhaps, been used more extensively than any other, is *Daniell's Hygrometer*. This is shown in Fig. 1. It consists essentially of a glass tube, bent twice at right angles, and with a bulb at each end. One limb of the apparatus is usually much shorter than the other, as shown. The bulb on the short limb is surrounded by a wrapping of fine muslin.

FIG. 1.

In the long limb is placed a thermometer reaching to the centre of the bulb carried by this limb. This bulb has a polished gilt band upon it, on which the dew is deposited during a determination of the dew-point.

Enough ether is contained in the apparatus to fill about three-quarters of the bulb on the longer limb. The rest of the apparatus is filled with ether vapour only, the air having been expelled by boiling the ether in the tube before it is sealed up. The hygrometer is supported on a stand, which usually carries another thermometer for comparison with the one in the hygrometer, so that the temperature of the air outside and the temperature of the gilt bulb can both be ascertained.

When the surface of a liquid is exposed, evaporation is always taking place. The molecules which leave the surface are, on the whole, those moving with greater velocities than the average velocity of the molecules of the liquid, that is, those possessing more than the average amount of kinetic energy. If this evaporation then takes place, it tends to reduce the average energy of the molecules remaining behind—that is, it reduces the temperature of the liquid.

If, however, the space above the liquid is enclosed, many of the gaseous molecules, rebounding from the walls of the enclosure, re-enter the liquid; and, as a matter of fact, a state of equilibrium is soon arrived at, in which as many molecules re-enter the liquid as leave it in a given time. The decrease in the volume then ceases, and apparently the evaporation ceases.

For each temperature we have a definite ratio between the number of molecules per unit volume in the liquid and the number per unit volume in the space above.

If the temperature of the liquid is raised, the kinetic energy of the molecules is increased and more leave the surface, and the ratio of the number of the molecules per c.c. in the space above to the number per c.c. the liquid becomes greater. On the other hand, if we cool the liquid, more molecules re-enter the liquid than leave it, until the equilibrium ratio for the new temperature is reached. In the case of an experiment with the Daniell's hygrometer, a little ether is poured on the muslin surrounding the bulb on the short limb of the tube. Some of the ether evaporates into the air, thus cooling the ether which remains behind, and cooling the muslin and the bulb. (We may also express the action in this way. The ether evaporates, and takes an amount of heat equal to its latent heat from the muslin, the glass bulb, and the surrounding air.)

The glass becoming cooled acts on the ether vapour inside and cools this, reducing the velocity with which the molecules move. The consequence is that the molecules begin to coalesce and pass into the liquid form. The state of affairs inside the apparatus then becomes as follows: Molecules of ether are leaving the gilt bulb, and these travel with a certain velocity. Many of them travel to the other bulb, and some of them are condensed to the liquid form.

Under these conditions as many molecules do not re-enter the liquid in the gilt bulb as leave it, and there is a balance in favour of evaporation. The ether in the gilt bulb gradually decreases in amount, and that in the other bulb increases. As a result, the ether remaining in the bulb becomes cooled considerably, and this cools the glass and the gilt band. When the temperature of the gilt band reaches the temperature at which the air is saturated with the moisture which it contains, dew begins to be deposited on the gilt band, causing it to appear dim. As soon as the dew appears the temperature of the thermometer in the tube is read. No more ether is poured on the muslin, and after a little time the temperature begins to rise again. The gilt band is watched closely, and as soon as the band again becomes bright, owing to the evaporation of the dew, the temperature of the bulb is again read. The mean of the two readings gives the dew-point approximately.

Having made a first determination, the operation is repeated more carefully, and as the dew-point is approached, care is taken to cool the apparatus very slowly, so as to allow a more accurate reading of the dew-point. Several determinations should be made and the mean taken.

Several objections have been raised to the Daniell's hygrometer. The first is, that the temperature registered by the internal thermometer is not necessarily the temperature of the gilt band, for both the ether and the glass are bad conductors of heat. The second is, that the ether poured on to the muslin vitiates the air in the neighbourhood of the instrument, and may affect the temperature at which moisture is deposited.

Regnault's Hygrometer.—In Regnault's hygrometer the cooling is again produced by the evaporation of ether, but the mechanical arrangements are modified to remedy the defects of Daniell's hygrometer.

FIG. 2.

The ether is contained in a tube, the lower portion of which is made of a thin thimble of polished silver. The advantage of this is, that the ether is in contact with a good metallic conductor, instead of a bad conductor like glass. The polished surface is therefore much more likely to be at the same temperature as the ether.

Again the ether is caused to evaporate, by a stream of air being drawn through it by means of an aspirator placed some distance away from the hygrometer.

The air enters the ether by a tube passing through a hole in a cork in the mouth of the tube containing the ether. It bubbles through the liquid, and is drawn out by the second tube which is connected to the aspirator. This current of air serves two purposes. It causes the ether to evaporate quickly, so that the dew-point is soon reached. It also stirs up the ether, making the temperature uniform throughout, and ensuring that the reading of the thermometer gives as nearly as possible the temperature of the outside of the silver thimble.

Sometimes a second tube, also with a silver thimble and thermometer, is placed alongside the one containing the ether so that the two silver surfaces may be compared. This makes it a little easier to detect the first deposition of dew.

As with the Daniell's hygrometer, after a first rough determination has been made, several careful ones should be made and the mean of the readings taken.

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Rex.—A specimen of bronze consisted of 85 per cent. of copper, 10 per cent. of zinc, and 5 per cent. of tin, whilst a specimen of bell-metal contained copper and tin only. The two specimens were fused together, and the mixture was found to contain 84 per cent. of copper, 8 per cent. of zinc, and 8 per cent. of tin. Find the proportion of copper and tin in the bell-metal.

Suppose we have to fuse m parts by weight of the bronze with n parts of the bell-metal in order to produce the required mixture. Then in $(m+n)$ parts of the mixture $\frac{10m}{100}$ parts are zinc. This amounts to $\frac{10m}{m+n}$ per cent. Hence by the question we have $\frac{10m}{m+n}=8$. Therefore $2m=8n$. That is $m:n::4:1$.

Hence the required mixture is made by taking 4 parts by weight of the bronze to 1 part of the bell-metal. Let x be the percentage of tin in the bell-metal. Then in 5 parts by weight of the mixture we shall have $\left(4\times\frac{5}{100}+\frac{1\times x}{100}\right)$ parts of tin; that is, we shall have $\frac{20+x}{5}$ per cent. of tin in the mixture. By the question we have

$$\frac{20+x}{5}=8.$$

$$\therefore\ x=20.$$

The bell-metal therefore contains 20 per cent. of tin and 80 per cent. of copper.

Grimsby.—Show that if

$$x+y+2=0,$$

and also $$\frac{x^2}{b-c}+\frac{y^2}{c-a}+\frac{2^2}{a-b}=0;$$

then will $$\frac{x}{b-c}=\frac{y}{c-a}=\frac{2}{a-b}.$$

From the first equation we have

$$y=-(2+x).$$

Substituting this value of y in the second equation, we have

$$\frac{x^2}{b-c}+\frac{(-2-x)^2}{c-a}+\frac{4}{a-b}=0.$$

$$\therefore\ \frac{x^2}{b-c}+\frac{4+4x+x^2}{c-a}+\frac{4}{a-b}=0.$$

$$\therefore\ \left(\frac{1}{b-c}+\frac{1}{c-a}\right)x^2+\frac{4}{c-a}\cdot x+4\left(\frac{1}{c-a}+\frac{1}{a-b}\right)=0.$$

$$\therefore\ (a-b)^2x^2-4(a-b)(b-c)x+4(b-c)^2=0.$$

$$\therefore\ \{(a-b)x-2(b-c)\}^2=0.$$

$$\therefore\ x=2\cdot\frac{b-c}{a-b}.$$

$$\therefore\ \frac{x}{b-c}=\frac{2}{a-b}.$$

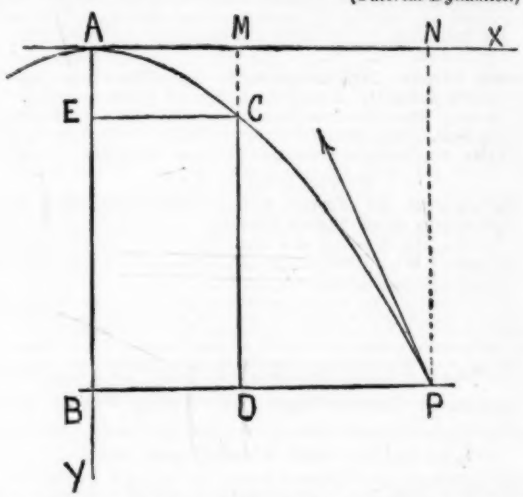
But $$y=-2-x=-2-2\frac{b-c}{a-b}=2\frac{c-a}{a-b}.$$

$$\therefore\ \frac{y}{c-a}=\frac{2}{a-b}.$$

Hence $$\frac{x}{b-c}=\frac{y}{c-a}=\frac{2}{a-b}.$$

Amos.—There are two poles of heights h and H feet at a distance d feet apart. From what point on the ground must a stone be projected if it is just to go over the first and lower pole and just to reach the top of the second and higher pole?

(*Tutorial Dynamics.*)



Let AB be the higher pole and CD the lower pole, and let P in the horizontal through BD be the point on the ground from which the stone must be projected. Then by § 224 we have a parabola PCA described by the stone; and since A is the highest point reached by the stone, this point must be the vortex of the parabola. Further, by § 224 we see that $\frac{(PB)^2}{BA}=m$, and $\frac{(CE)^2}{EA}=m$ where m is a constant.

Hence $$\frac{(PB)^2}{BA}=\frac{(CE)^2}{EA}.$$

Let x denote the distance PD in feet. Then, since by the question $DB=d$ feet, $PB=(x+d)$ feet. Also, $CE=DB=d$ feet, and $EA=BA-DC=(H-h)$ feet.

Therefore $$\frac{(x+d)^2}{H}=\frac{d^2}{H-h}.$$

$$\therefore\ \left(\frac{x+d}{d}\right)^2=\frac{H}{H-h}.$$

$$\therefore\ \frac{x+d}{d}=\sqrt{\frac{H}{H-h}}.$$

$$\therefore\ x=d\left\{\sqrt{\frac{H}{H-h}}-1\right\}.$$

Hence the stone must be projected from a point on the ground distant $d\left\{\sqrt{\frac{H}{H-h}}-1\right\}$ feet from the foot of the lower pole.

Bike.—Two imperfectly elastic spheres approach along parallel lines with equal but opposite momenta. Show that after oblique impact they separate along parallel lines which are at a greater distance apart than the first pair of lines.

(*Cambridge Entrance.*)

Let M, M^1 represent the masses of the spheres, and V, V^1 their velocities before impact, the directions of either making the

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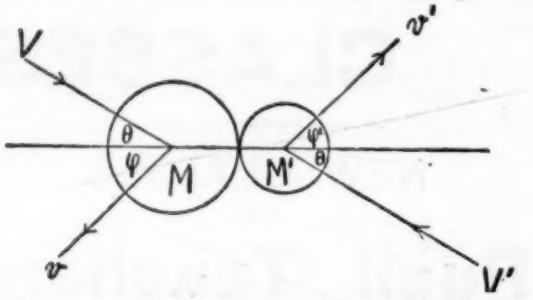
angle θ with the line of impact. Let v, v^1 be the velocities after impact, their directions making the angles ϕ, ϕ^1 with the line of impact, the measurements being taken as indicated in the figure.



Since the velocity of either sphere perpendicular to the line of impact will be the same after impact as before, we shall have

$$v \sin \phi = V \sin \theta \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$v^1 \sin \phi^1 = V^1 \sin \theta \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

By Newton's law for the relative velocity in the line of impact we have

$$v \cos \phi + v^1 \cos \phi^1 = eV \cos \theta + eV^1 \cos \theta \quad . \quad . \quad (3)$$

Further, since the total momentum in the line of impact is the same after impact as before, we have

$$Mv \cos \phi - M^1 v^1 \cos \phi^1 = -MV \cos \theta + M^1 V^1 \cos \theta.$$

But, by the question, $MV = M^1V^1$; therefore

$$Mv \cos \phi - M^1 v^1 \cos \phi^1 = 0 \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Multiplying equation (3) by M^1 and adding to equation (4) we have

$$M^1 v \cos \phi + Mv \cos \phi = e \cos \theta \, (M^1V + M^1V^1).$$

$$\therefore \; v \cos \phi = \frac{M^1V + M^1V^1}{M^1 + M} \cdot e \cos \theta.$$

But $M^1V^1 = MV$; therefore

$$v \cos \phi = \frac{M^1V + MV}{M^1 + M} \cdot e \cos \theta.$$

$$\therefore \; v \cos \phi = eV \cos \theta \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

Then, from (5) and (3) we have

$$v^1 \cos \phi^1 = eV^1 \cos \theta \quad . \quad . \quad . \quad . \quad . \quad (6)$$

Dividing (1) by (5) we have

$\tan \phi = \frac{1}{e} \cdot \tan \theta$; and dividing (2) by (6) we have $\tan \phi^1 = \frac{1}{e} \tan \theta$.

By the question $\frac{1}{e} > 1$, therefore $\phi^1 = \phi > \theta$.

Hence the spheres will separate upon parallel lines which are at a greater distance apart than the parallel lines along which they approached.

Timbre.—State the values of A for each of which two terms of the expression

$\tan (60° + A) \cdot \tan (60° - A) + \tan (60° - A) \tan A - \tan A \cdot \tan (60° + A)$

would become infinitive, one positive and the other negative, and, excluding those values, show that for all other values of A the expression is equal to 3.

(*Third Stage Mathematics*, 1905.)

The angles excluded are those which make

$$A, (60° - A) \text{ or } (60° + A)$$

a right angle or an integer multiple of a right angle, positive or negative.

Thus if n denote any positive or negative integer the angles are

$$n\frac{\pi}{2}, \; n\frac{\pi}{2} - \frac{\pi}{3}, \; \frac{\pi}{3} - n\frac{\pi}{2}.$$

Of these the positive angles less than 2π are

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Again $\tan 60° = \sqrt{3}$, $\therefore \tan (60° + A) = \frac{\sqrt{3} + \tan A}{1 - \sqrt{3} \tan A}$,

and $\tan (60° - A) = \frac{\sqrt{3} - \tan A}{1 + \sqrt{3} \tan A}$.

Hence the given expression is equal to

$$\frac{\sqrt{3} + \tan A}{1 - \sqrt{3} \tan A} \cdot \frac{\sqrt{3} - \tan A}{1 + \sqrt{3} \tan A} + \frac{\sqrt{3} - \tan A}{1 + \sqrt{3} \tan A} \cdot \tan A$$

$$- \tan A \cdot \frac{\sqrt{3} + \tan A}{1 - \sqrt{3} \tan A}$$

$$= \frac{3 - \tan^2 A}{1 - 3 \tan^2 A} + \frac{\sqrt{3} \tan A - \tan^2 A}{1 + \sqrt{3} \tan A} - \frac{\sqrt{3} \tan A + \tan^2 A}{1 - \sqrt{3} \tan A}$$

$$= \frac{3 - \tan^2 A + \sqrt{3} \tan A - \tan^2 A - 3 \tan^2 A + \sqrt{3} \tan^2 A - \sqrt{3} \tan A - \tan^2 A - 3 \tan^2 A - \sqrt{3} \tan^2 A}{1 - 3 \tan^2 A}$$

$$= \frac{3 - 9 \tan^2 A}{1 - 3 \tan^2 A} = 3.$$

L. C. P.—Given Euler's theorem that

$$lt_{n=\infty} \cos \frac{x}{2} \cos \frac{x}{2^2} \cos \frac{x}{2^3} \ldots \ldots \cos \frac{x}{2^n} = \frac{\sin x}{x},$$

prove $\frac{1}{2} \tan \frac{x}{2} + \frac{1}{2^2} \tan \frac{x}{2^2} + \frac{1}{2^3} \tan \frac{x}{2^3} + \ldots \ldots$ ad. inf. $= \frac{1}{x} - \cot x$

and $\frac{1}{2^2} \sec^2 \frac{x}{2} + \frac{1}{2^4} \sec^2 \frac{x}{2^2} + \frac{1}{2^6} \sec^2 \frac{x}{2^3} + \ldots$ ad. inf. $= \operatorname{cosec}^2 x - \frac{1}{x^2}$.

(Edwards' *Differential Calculus.*)

On taking logarithms of both sides of the given identity we have

$$\log \cos \frac{x}{2} + \log \cos \frac{x}{2^2} + \log \cos \frac{x}{2^3} + \ldots \ldots + \log \cos \frac{x}{2^n}$$

$$= \log \sin x - \log x \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Now $$\frac{d}{dx} \left(\log \cos \frac{x}{2^r} \right) = \frac{1}{\cos \frac{x}{2^r}} \cdot \frac{d}{dx} \cos \frac{x}{2^r}$$

$$= \frac{1}{\cos \frac{x}{2^r}} \cdot \left(- \sin \frac{x}{2^r} \right) \cdot \frac{d}{dx} \left(\frac{x}{2^r} \right) = - \tan \frac{x}{2^r} \cdot \frac{1}{2^r},$$

where r may be any member of the Series $1, 2, 3 \ldots \ldots n$.

. Also $\frac{d}{dx} (\log \sin x) = \frac{1}{\sin x} \frac{d}{dx} (\sin x) = \frac{1}{\sin x} \cdot \cos x = \cot x$,

and $$\frac{d}{dx} (\log x) = \frac{1}{x}.$$

Hence on differentiating both sides of (1) we have

$$- \frac{1}{2} \tan \frac{x}{2} - \frac{1}{2^2} \tan \frac{x}{2^2} - \frac{1}{2^3} \tan \frac{x}{2^3} - \ldots \ldots \text{ ad inf.} = \cot x - \frac{1}{x},$$

$$\therefore \frac{1}{2} \tan \frac{x}{2} + \frac{1}{2^2} \tan \frac{x}{2^2} + \frac{1}{2^3} \tan \frac{x}{2^3} + \ldots \ldots \text{ ad. inf.} = \frac{1}{x} - \cot x.$$

$$\ldots \ldots \ldots \quad (2)$$

Again $$\frac{d}{dx} \left(\tan \frac{x}{2^r} \right) = \sec^2 \frac{x}{2^r} \frac{d}{dx} \left(\frac{x}{2^r} \right) = \frac{1}{2^r} \sec^2 \frac{x}{2^r}.$$

Also $$\frac{d}{dx} (\cot x) = - \operatorname{cosec}^2 x \; ; \; \frac{d}{dx} \left(\frac{1}{x} \right) = - \frac{1}{x^2}.$$

Hence on differentiating both sides of (2) we have

$$\frac{1}{2} \cdot \frac{1}{2} \sec^2 \frac{x}{2} + \frac{1}{2^2} \cdot \frac{1}{2^2} \sec^2 \frac{x}{2^2} + \frac{1}{2^3} \cdot \frac{1}{2^3} \sec^2 \frac{x}{2^3} + \ldots \ldots \text{ ad inf.}$$

$$= \operatorname{cosec}^2 x - \frac{1}{x^2},$$

or $$\frac{1}{2^2} \sec^2 \frac{x}{2} + \frac{1}{2^4} \sec^2 \frac{x}{2^2} + \frac{1}{2^6} \sec^2 \frac{x}{2^3} + \ldots \ldots \text{ ad. inf.}$$

$$= \operatorname{cosec}^2 x - \frac{1}{x^2}.$$

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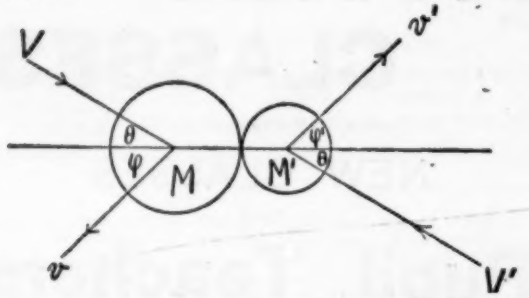

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$$= \frac{3 - \tan^2 A + \sqrt{3} \tan A - \tan^2 A - \sqrt{3} \tan^3 A + \sqrt{3} \tan^3 A - \sqrt{3} \tan A - \tan^2 A - \sqrt{3} \tan^3 A - \sqrt{3} \tan A}{1 - 3 \tan^2 A}$$

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$$= \frac{1}{\cos \dfrac{x}{2^r}} \cdot \left(-\sin \frac{x}{2^r}\right) \cdot \frac{d}{dx}\left(\frac{x}{2^r}\right) = -\tan \frac{x}{2^r} \cdot \frac{1}{2^r},$$

where r may be any member of the Series 1, 2, 3 . . . . . n.

Also $\frac{d}{dx} (\log \sin x) = \frac{1}{\sin x} \frac{d}{dx} (\sin x) = \frac{1}{\sin x} \cdot \cos x = \cot x$,

and $$\frac{d}{dx} (\log x = \frac{1}{x}.$$

Hence on differentiating both sides of (1) we have

$$-\frac{1}{2} \tan \frac{x}{2} - \frac{1}{2^2} \tan \frac{x}{2^2} - \frac{1}{2^3} \tan \frac{x}{2^3} - \ldots \ldots \text{ ad inf.} = \cot x - \frac{1}{x},$$

$$\therefore \frac{1}{2} \tan \frac{x}{2} + \frac{1}{2^2} \tan \frac{x}{2^2} + \frac{1}{2^3} \tan \frac{x}{2^3} + \ldots \ldots \text{ ad. inf.} = \frac{1}{x} - \cot x.$$

$$\ldots \ldots \ldots \quad (2)$$

Again $$\frac{d}{dx}\left(\tan \frac{x}{2^r}\right) = \sec^2 \frac{x}{2^r} \frac{d}{dx}\left(\frac{x}{2^r}\right) = \frac{1}{2^r} \sec^2 \frac{x}{2^r}.$$

Also $$\frac{d}{dx} (\cot x) = -\operatorname{cosec}^2 x \; ; \; \frac{d}{dx}\left(\frac{1}{x}\right) = -\frac{1}{x^2}.$$

Hence on differentiating both sides of (2) we have

$$\frac{1}{2} \cdot \frac{1}{2} \sec^2 \frac{x}{2} + \frac{1}{2^2} \cdot \frac{1}{2^2} \sec^2 \frac{x}{2^2} + \frac{1}{2^3} \cdot \frac{1}{2^3} \sec^2 \frac{x}{2^3} + \ldots \ldots \text{ ad inf.}$$

$$= \operatorname{cosec}^2 x - \frac{1}{x^2},$$

or $$\frac{1}{2^2} \sec^2 \frac{x}{2} + \frac{1}{2^4} \sec^2 \frac{x}{2^2} + \frac{1}{2^6} \sec^2 \frac{x}{2^3} + \ldots \ldots \text{ ad. inf.}$$

$$= \operatorname{cosec}^2 x - \frac{1}{x^2}.$$

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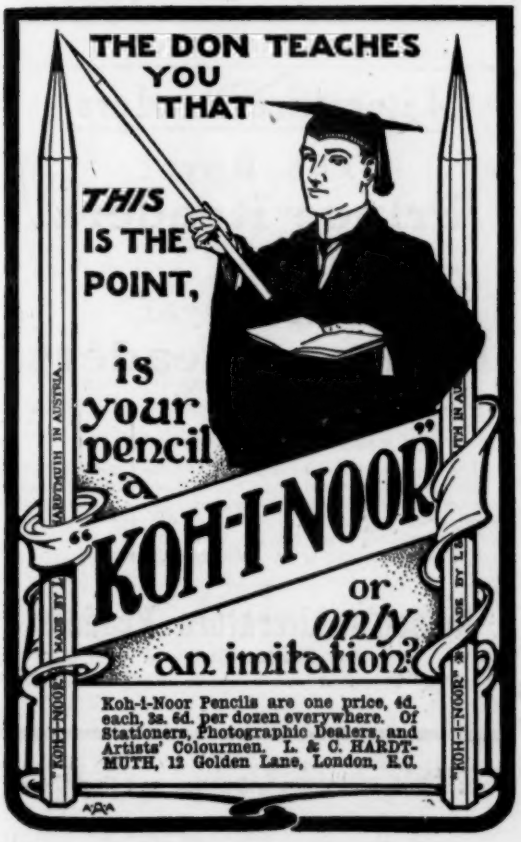
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